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SEVENTEENTH BIENNIAL REPORT

OF THE

IOWA STATE COLLEGE OF AGRICULTURE

AND MECHANIC ARTS,

INCLUDING

REPORT OF EXPERIMENT STATION,

MADE TO

The Governor of the State

FOR THE YEARS 1896 AND 1897.

PRINTED BY ORDER OF THE GENERAL ASSEMBLY.

DES MOINES:
CONAWAY & SHAW, PRINTERS.
1898.

SEVENTEENTH BIENNIAL REPORT

OF THE

UNIV. OF CALIFORNIA

IOWA STATE COLLEGE OF AGRICULTURE

AND MECHANIC ARTS.

MADE TO

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IOWA STATE COLLEGE OF AGRICULTURE
AND MECHANIC ARTS,
AMES, Iowa, December 1, 1897.

To His Excellency, Francis M. Drake:

In accordance with the statute defining the duties of the secretary of the board of trustees of the Iowa State College of Agriculture and Mechanic Arts, I have the honor to transmit herewith the seventeenth biennial report of the board.

E. W. STANTON,
Secretary.

539747

UNIV. OF
CALIFORNIA

REPORT OF THE PRESIDENT.

To the Board of Trustees of the Iowa State College of Agriculture and Mechanic Arts:

GENTLEMEN—I am empowered to present to you for his excellency, Francis M. Drake, governor of Iowa, and for the citizens of Iowa, my biennial report for the incoming general assembly.

OUR BIENNIAL PROGRESS.

In our biennial progress, the students, the faculty and the respective departments of the institution have attained in this period a most encouraging and harmonious condition of growth and work.

Margaret hall for young women has added greatly to the comfort, efficiency and social advantages of not only the young women, but of the entire school. The new quarters for training young women in household economy, in housekeeping and home-making, have markedly added interest and thrift to the work of the college.

The emergency fund for deep well has enabled the authorities to sink a well 2,215 feet deep with the most satisfactory results. The quality of the water by analysis compares most favorably with similar wells in this section of Iowa, and is well adapted for both household and mechanical purposes. The quantity is practically inexhaustible, and comes within twenty feet of the top of the ground. A deep well pump of improved pattern is attached to the well and works successfully. A tower and steel and iron tank of pleasing pattern and useful with capacity of 163,000 gallons, has been erected and design proved in every way adequate to the needs of our water supply. A complete system of water mains has been constructed with the water tower, so that we now have ample protection for the buildings against fire and an adequate amount of water for the living purposes of the college community. This also insures us sufficiency of water for the sewerage of the college buildings. By more careful inquiry the trustees found that there was some doubt about the disposal of the sewage by sand filter beds, as at first contemplated, so that they have decided to connect the cottage dormitories, the hospital, the veterinary hospital and other buildings with the main college sewer, and by using the plenteous water supply now afforded at slight cost dispose of the sewage by the system of water drainage which is now in vogue throughout the towns and cities.

The appropriation made by the last legislature for the fixing of the farm barns has been judiciously expended. The entire basement of the barns has been torn out and put in anew, giving ample provisions of stalls for the herds of the farm and affording modern improvements for the management of experiments in dairying and animal husbandry. The foundations of the barns were put in mostly anew. The original foundations had been made of poor material, and were caving in. This required new walls of about ten or twelve feet in height for the entire basement.

The greenhouse, of an improved pattern, has been erected in accord with the appropriation granted for said purpose. While it is not nearly as commodious as an institution of this magnitude should have, yet as far as it goes it serves the purpose very well.

A building for forge shop and foundry has been erected. This has been a long felt need in our work in the engineering departments. The building will enable us to do much more and better work in these lines.

GENERAL REPAIRS AND IMPROVEMENTS.

Repairs and improvements have been made in most of the buildings. A number of them have been replastered. New blackboards have been put in main building and Agricultural hall. Fire-closets, elevator, and fire-escapes have been added to Margaret hall. Furniture and fixtures have been also placed in this building, for both the living rooms and the department of domestic economy. A new roof has been put upon North hall, and important repairs and improvements have been added to the creamery building. The rooms of the botany department have been provided with new casing for the growing collection of plants. Ten of the houses set apart for the living of professors have been improved. These all bring a good rental to the state. The boilers of the larger buildings have been put under a thorough system of repairs and inspection. Main building and engineering hall have received additional repairs. The laboratory facilities of agricultural chemistry have been enlarged to meet the growing demand for the analysis of sugar beets and other important specimens undergoing investigation in this department. The electric light plant has been enlarged to meet the demands of the respective buildings. The building for physics and chemistry has been improved. The farm fences have been decidedly improved in the immediate vicinity of the barns. New railing and screens have been placed in the library. A number of the buildings have been repainted without and varnished within. These and numerous other minor improvements have put our college plant in a much better condition, and aggregate upon the whole a cost of $20,000 during the last biennial period. An itemized statement of these additions and repairs will be found among the tables of the expenditures attending this report.

NEEDS UNASKED FOR AT PRESENT.

In view of the pressing demands made upon the state for money, there are a number of very important needs of this college which our authorities have deemed best not to ask at present.

Our engineering departments are seriously in need of a larger building for the general purposes of instruction, laboratories, museums and recitation rooms. In electrical engineering we are compelled to scatter work into seven or eight different rooms, most of which are in basements. We are forced to crowd the work of mechanical engineering and civil engineering in a building inadequate for the needs of these departments. A structure suitable for the general purposes of the engineering departments would cost about $75,000. We are still among the few colleges of this character and rank in the United States without an armory for military tactics and quarters for the physical training of the students. For these purposes we asked the last legislature for $28,000. This is a modest sum, and the appropriation for such a building should exceed that amount.

We are still in need of machine shops, which should cost at least $8,000 to $10,000. Whatever may be the outcome of animal industry in this country, there will be in connection with the experiment station always a demand for a veterinary hospital barn for dissecting room and treating infectious diseases of domestic animals. This would cost at least $5,000 There are other important needs of like worth that call for early appropriation of more money for meeting the growing needs of our work.

NEEDS ASKED FOR AT PRESENT—CARPENTER SHOPS.

We have repeatedly made an appeal to the legislature for carpenter shops in connection with the engineering courses of our work. We are compelled to make a still more strenuous appeal of this character than ever. Our present quarters are worn out and dilapidated. They consist of an old frame building that has long spent its usefulness and is occupied only by the force of circumstances. It is a constant menace to the safety of adjoining buildings. It is not worth repairing. It is ill-arranged, and cannot be made comfortable and invitingly habitable in the inclement weather of the fall and spring. We should have every cent of $8,000 for new shops, and more if at all possible.

ADDITIONS TO THE COLLEGE LIBRARY.

With the demands made upon our finances, we are unable as a college to expend more than about $2,000 a year in the purchase of new books for the library. We have thus been enabled to collect a library of about 11,000 volumes and 2,000 pamphlets. A large part of the work done by these modern methods of teaching is by original study and research by the student in the library under an efficient instructor and guide. A great institution like that of the Iowa State College of Agriculture and Mechanic Arts should have at least 50,000 volumes at once in its library and make large increase thereto each succeeding year. The college has about one-fifth of that amount at present. An investment of this kind in books will bring the best minds, the largest thought and the noblest forces of the centuries to the present touch and inspiration of the youth in the college. The amount of $15,000 is asked for making additions to the library. I sincerely hope this sum will be increased by the legislative authorities. There is no one investment, apart from a live teacher, of more far-reaching and permanent good in the education of our Iowa boys and girls than that of putting them in studious touch with a large amount of useful literature.

HORSE BARN AND SILO.

We are seriously in need of a commodious horse barn. Our present building is an old brick stable, much humbler in pretension than that of a small land owner. The demand made upon us for instruction and illustration in this part of animal husbandry requires a barn of modern and suitable dimensions. Our work is seriously hindered on account of the lack of such a building. It is desirable to build, in connection with it, a silo with a capacity of 400 tons in order that we may have proper facilities for feeding in accord with this important method of preserving foods. We ask $7,500 for these purposes.

THE CHAIR OF PEDAGOGY.

We still find a growing demand for a chair of pedagogy in connection with our college. Quite a number of our graduates desire instruction in the methods of teaching. A large per cent of our students are teachers in the public schools during the long winter vacations, and a number make their way through school in this manner. For a comparatively small expenditure of $2,000 a year for maintaining a chair in teaching, we could offer a chair in pedagogy that would be most helpful to the teachers and the youth of the state. We have excellent laboratory facilities in the sciences, and thorough instruction in mathematics and English and the modern languages, all of which can be turned to a student in the science and art of teaching without extra expenditure. The establishment of this chair is indorsed by the teaching fraternity of Iowa.

RESIDENCE FOR THE PRESIDENT.

The venerable Dr. Welch in his day erected a residence of his own on a lot adjoining the southeast corner of the college domain. This property is now owned by his heirs. Of a preceding legislature $6,000 were asked by the heirs for the property. It consists of a two-story brick house and four acres of ground. It contains nine rooms and a commodious hallway, with a cellar under the entire house. It is well constructed and tastefully furnished throughout. The grounds are finely landscaped and beautifully ornamented by shrubs and trees, which have now grown to pleasing proportions. The property can be bought for $3,000. It is customary for institutions of this character to have a residence for the president. This property is a bargain at the price, and would prove a valuable investment.

SHEEP BARN, FENCING, BUILDING FOR MACHINERY, AND TILING NORTH FARM.

We are much in need of more adequate quarters for the handling of sheep. We have a couple of old buildings, which, with a small expenditure of money, could be combined and made over for quarters for the raising and care of sheep.

We have no suitable quarters for the farm machinery. By rearranging some of the upper part of the main barn, desirable quarters could be made for the storing of the farm machinery. It is also desirable to have in connection with the machinery a room for the instruction of young men in the structure, handling, and mastery of the various implements of machinery having to do with agriculture. Such instruction is now usual in the leading colleges.

Much of the fencing on the farm has not been changed or improved for many years. The fences are worn out and there is such extensive demand for refencing that the ordinary appropriation for these improvements does not catch up with demands of this character.

North farm possesses some of the best soil of the whole college possessions, but much of it lies low down near the creek and is not tillable without thorough drainage. Tiling would add much to its value and the income of the farm. For all of these objects,—sheep barn, fencing, enlarging building for machinery and tiling,—$3,100 is asked, and divided as follows:

1. Sheep barn	$ 1,900
2. Extension of old barn for additional implement and tool room	600
3. Fencing and tiling	1,500
Total	$ 3,100

FITTING AND EQUIPMENT FOR AGRICULTURAL MUSEUM.

As an institution we ought to have a collection of plants, seeds, field products, specimens, and objects for observation and illustration in scientific agriculture. These are generally entitled an agricultural museum. Situated as we are in this middle west with vast agricultural interests about us, we should have one of the largest and choicest collections of such a character in the country. To this end it will be necessary to fit up a large room with proper divisions, shelvings, casings, etc., for suitable display and observation of various specimens. We ask the legislature for $1,000 to fit up such a hall.

MINING ENGINEERING LABORATORY AND EQUIPMENT.

By reason of the hard times we have been economizing in every possible way in connection with the mining engineering department. We have been enabled by the equipment in the other courses to afford excellent advantages by a small expenditure of money for the specific purposes of mining engineering. It would be well to expend $1,000 for mining engineering laboratory and equipment. This amount, in connection with the equipment of the other engineering departments, would enable us for a nominal sum to furnish additional facilities in this department far beyond the amount of $1,000.

GENERAL TELEPHONE AND ELECTRIC LIGHT SYSTEM FOR THE PUBLIC GROUNDS.

The college is now included in the corporation of Ames. We are too far from the electric light plant at Ames to have the benefit of the electric lighting of the city system. The city council had voted a small amount of money for the lighting of the college grounds and roads about the campus. With a small additional expenditure of money the college could light the grounds quite successfully from its own plant. Light is a great civilizing and educational force, and we should have the benefit of this lighting system at once.

It is also desired to connect the various buildings of the college by a complete telephone system. This would greatly facilitate much of the business of the college. For both of these objects we ask $1,000.

FARM DAIRY ROOM.

There is a marked demand throught the state in regard to more definite instruction in home dairying. As the work of the creamery has become more thoroughly systematized, there is a growing want for knowledge as to the best methods of conducting dairy interests upon the farm itself. This is now one of the pressing needs of the progressive Iowa farmer. We desire to meet it at once. One portion of our present creamery building, by some convenient changes, can be made into a very suitable room for teaching and illustrating farm dairying. For making and fitting up this room there will be required about $875.

GOVERNOR AND SUPERINTENDENT OF PUBLIC INSTRUCTION TO BE MADE EX-OFFICIO MEMBERS OF THE BOARD OF TRUSTEES.

As one of the three educational institutions of Iowa, we believe it would be for the advantage of our educational system, as a state, to have the governor and superintendent of public instruction members ex-officio of the board of trustees in this college. The governor, as the head of all the state institutions, is usually an ex-officio member of the board of trustees of the educational institutions in the respective states of the union. The superintendent of public instruction, by the nature of his office, ought to be a member of the board of trustees of each state educational institution of the state.

PURCHASE OF LAND.

There is some land joining the college farm that would add greatly to the service and efficiency of the farm department if owned by the college. Part of it projects into the colleeg farm, making it quite irregular in shape, very inconvenient, and expensive in regard to fencing. The purchase of not to exceed eighty acres, adjoining the present college farm, would not incur any additional expenditure upon the part of the state. This land can be purchased from the endowment fund in accord with the provisions of the national grant. It is most urgently requested that the trustees be empowered to make said purchase.

CHANGE OF COLLEGE FISCAL YEAR.

The educational machinery of the colleges in the United States is set for midsummer and not for November. The government at Washington requires the reports to cover the period ending the 30th of June of each year. The fiscal year of most of the state institutions is now fixed to begin on July 1st. With our present arrangement it is almost impossible to meet the requirements of the national government in regard to reports June 30th. We therefore ask that the fiscal year of the college be fixed to begin July 1st of each year.

SUMMARY.

1.	Carpenter shops	$ 8,000
2.	Purchase of books for library	15,000
3.	Horse barn and silo	7,500
4.	Chair of pedagogy	4,000
	Residence for president	3,000

6. Farm improvements:	
1. Sheep barn	1,000
2. Extension of main barn for implement, tool and instruction room	600
3. Fencing and tiling	1,500
7. Agricultural hall museum, fittings and equipment	1,000
8. Mining engineering laboratory and equipment	1,000
9. General telephone and public grounds electric light system	1,000
10. Farm dairy room	875
Total	$44,475

11. We ask that the governor and superintendent of public instruction be added to the board of trustees, as members *ex-officio*.

12. We ask that the board of trustees be authorized to purchase not to exceed eighty acres of land adjoining the present college farm, and to pay therefor from endowment fund in accordance with the provisions of the original national grant.

13. We ask that the college fiscal year be definitely fixed to begin on July 1st.

ADDITIONS TO THE COURSE OF STUDY.

In recent years the land-grant colleges of the United States have been making important changes as to their courses of study. As an institution we have been quite fortunate in keeping abreast with the times in the topics taught and the arrangement made in the respective courses. We have found it necessary to add to our courses of study the addition of an entire school year. The college has prefixed to all courses an additional academic year, of which the requirements for admission are equivalent to the present requirements of the first term freshman year of the several courses, with such modifications as are necessary in the courses of agriculture and veterinary science. Admission to the courses by certificate from high school is restricted to graduates of high schools, approved by the college section of the State Teachers' association, except that all candidates to the freshman class are required to take entrance examination in mathematics. In consequence of this change we have made important additions to the studies of our freshman and sophomore years. In the junior and senior years we had a generous system of electives strictly guarded which rendered those years satisfactory without much modification.

CHANGE OF COLLEGE YEAR

The universal experience of the colleges of America is against the fall commencement exercises. In the beginning history of these colleges quite a number had their commencement in the fall, owing to manual training required of the students in the field, but that system has long gone out of practice. We are the only college in America whose commencement is left for the fall. This simple fact is more eloquent and convincing for a change than any argument that could be produced. All the colleges have found it impracticable to finish up the college year at such a time. Graduates who wish to take teaching work as their profession or engage in any of the industries find suitable openings in midsummer rather than midfall. Those who wish to take post-graduate work in other institutions should begin early in September, and must in October. In a word, November is a poor time for the graduates of the college to secure openings for their life undertakings; so we have decided to leave our terms and vacations just as they are and change the date of commencement to June and the beginning of the college year to July, instead of February as hitherto. In 1898 we will have two openings, one in February, according to the old plan, and one in July, according to the new plan.

PLAN OF CHANGING COLLEGE YEAR.

The plan of changing college year is as follows:

That the present senior class pursue the course as now in force and graduate in November, 1898;

That for the sophomore and junior classes each student shall elect his course, to terminate in November, according to the present course of study, or in the June following, according to the new course of study;

That students applying for admission to the college in March shall, if qualified, be classified in the senior academic term and shall graduate in 1902;

That students applying for admission to the college in July shall, if qualified, be classified as freshmen and shall graduate in 1902;

That students applying for admission to the college in July shall, if not qualified to enter the freshman class, be admitted, if qualified, to the junior term of the academic year.

THE WORK OF THE DEPARTMENTS.

I submit herewith a biennial report of the respective departments of the college. These give knowledge of the amount and character of the work done during the biennial period. We have a board of direction under the superintendence of the director of the experiment station and the president of the college, that outlines work of original investigation a year ahead. This board of direction is composed of the professors in agriculture, animal husbandry, dairying, botany, entomology, horticulture, agricultural chemistry, and veterinary science. A preview of the field to be gone over is made through free discussion with the beginning of each year. This contributes much to the consistency and value of original investigation in these various departments. The work of the other departments has made for the most part excellent progress both with the student and the instructors.

CONCLUSION.

It is most gratifying to report substantial and marked improvement in the material facilities and educational factors of the college during another biennial period. The present outlook bespeaks still larger and better things to come in the essential force of our work. We have graduated twenty-five classes. Our graduates number 898. These are the true indices of the success of the work. In positions of trust and power throughout the country, they are reflecting credit upon themselves and honor upon the college. Industrial and scientific education is opening into a vast field of usefulness and strength. The vision of the father of this character of colleges, Hon. Justin S. Morrill, is becoming a reality. He says: "That the act of 1862 was intended to give those whose lives were to be devoted to agriculture, or mechanic arts, or to the other industries embracing much of the largest part of our population, some chance to obtain a liberal and practical education." This "largest part of our population" is more than ever awaking to the privilege and opportunity of this and kindred colleges throughout the land. I hereby make sincere acknowledgment to the kindly hand and the thoughtful deed of each and of all who have contributed to the success of the seventeenth biennial period of the Iowa State College of Agriculture and Mechanic Arts.

Most respectfully submitted,

W. M. BEARDSHEAR,

President.

FINANCIAL REPORTS.

REPORT OF SECRETARY.

STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS,
November 10, 1897.

To the Honorable Board of Trustees:

GENTLEMEN—The college endowment fund is the same in amount as at the beginning of the biennial period, viz.: $681,033.52. Of this amount $591,354.01 is to be credited to the original congressional land grant, and $89,679.51 to the transfers and investments of interest fund made in the earlier days of the college when the income of the institution exceeded its expenditures. The endowment fund is invested in land and farm mortgages and is managed by the board of trustees through the following agencies:

1. Financial agency, under charge of Agent Helsell.
2. Land and loan agency, under charge of Agent Knapp.

I. FINANCIAL AGENCY.

At the beginning of the biennial period there was an uninvested balance in the financial agency of		$ 17,516.45
The agency has been debited with the proceeds of Des Moines Security Loan and Trust company debentures amounting to		5,500.00
Mortgage loans paid during the two years		78,826.86
Principal on leases paid during the two years		27,476.58
Making a total to be invested of		$ 129,319.89
The agent has loaned during the two years		100,200.00
Leaving an uninvested balance of		$ 29,119.89
Of which there is:		
In the hands of the financial agent		$ 5,300.00
In the hands of the state treasurer		23,819.89
Total		$ 29,119.89
Extensions have been granted during the biennial period amounting to		14,700.00
The total amount at present charged to the agency is $540,943.52, which is accounted for as follows:		
Farm mortgages bearing 8 per cent interest		$ 2,450.00
Farm mortgages bearing 7 per cent interest		504,073.63
Farm mortgages bearing 6 per cent interest		5,300.00
Total invested in mortgages		$ 511,823.63
Cash balance awaiting investment		29,119.89
Total		$ 540,943.52
Adding to the above the following mortgages foreclosed:		
Loan No. 168, security 120 acres in Ringgold county	$ 1,200.00	
Loan No. 229, security 40 acres in Polk county	2,418.55	
Total		$ 3,618.55
Gives the entire amount realized to date from sales of land belonging to the original congressional land grant, viz		$ 544,562.07

The Ringgold county tract is rented at an annual rental of $126; the Polk county tract on short time lease at $85.

An account is kept in my office with the financial agent. His drafts upon the state treasurer are countersigned by me and the amount of the draft charged on my books, against the agent. Under the statutes of the state the papers connected with all loans are forwarded to me and entered of record in the books of my office. Upon the receipt of the papers of any loan, I credit the agent with the amount thereof. These papers are then forwarded to the state treasurer, this officer being debited with the same upon my books. Payments of principal and interest are made to him. Upon the payment of the principal of any loan, the release of mortgage is executed by the chairman of the board of trustees and myself. The state treasurer is credited on his loan account with the amount of the loan and debited with the cash thus received. Any addition to the funds of the agency is made known to me by methods hereafter explained. I am thus able from the original papers to keep an account with the officers handling the funds of the agency. At the end of each month a trial balance is taken which shows the investments of the fund and the cash balance uninvested. Comparsions are made at the same time with the accounts of the state treasurer. Frequent comparisons are also made with the books of the financial agent. Upon the basis of the agreement of the books thus compared, I am able to determine the correctness of the accounts of the officers of this agency handling the endowment fund, and to certify that the statement contained in this report is an accurate exhibit of the present condition of this fund.

II. LAND AND LOAN AGENCY.

That portion of the original endowment fund still invested in land and the portion arising from the transfer and investment of interest fund are under the management of Agent Knapp. At the beginning of the biennial period there was charged to the land department of the agency the following:

Of the congressional grant, 18,861 94 acres, appraised at	$ 74,268.52
Of land purchased with accumulated interest, 1,253.17 acres, appraised at	5,999 51
Total, 20,118.11 acres, appraised at	$ 80,268.03
During the two years the following land has been patented:	
Of the congressional grant, 8,128.94 acres, appraised at	27,476.58
Leaving as the amount now charged to the agency—	
Of the congressional grant, 10,736 acres, appraised at	46,791.94
Of the land purchased with accumulated interest, 1,253.17 acres, appraised at	5,999.51
Total, 11,989.17 acres, appraised at	$ 52,791.45

All of the above land is under lease at an annual rental of 8 per cent on the appraised value. These leases have been renewed from time to time, the whole history of which is set forth on page 117 of the fifteenth biennial report of the college.

The renewals of leases during the biennial period amount to $8,582.20.

The proceeds of the sales, aggregating, as shown above, $27,476.58, have been remitted to the state treasurer and added to the funds of the financial agency. When a sale is made the certificate of purchase is signed by me and a duplicate of the receipt of the state treasurer is filed in my office. I then debit the state treasurer with the amount and credit the land agent.

It has been stated hitherto that the portion of the endowment fund derived from accumulated interest amounts to $89,679.51. Of this amount the sum of $5,999.51, as already shown, is in the shape of land and has been accounted for. The balance, $83,680, constitutes the amount charged to the loan department of Mr. Knapp's agency.

At the beginning of the biennial period there was an uninvested balance in his hands of	$ 1,330.00	
During the two years loans have been paid amounting to	25,650.00	
Making a total to be loaned of		$ 26,980.00
Of this amount Agent Knapp has loaned		24,450.00
Leaving a balance uninvested of		$ 2.530.00
Total amount at present invested in farm mortgages is		81,150.00
Total fund		$ 83,680.00

Summarizing the foregoing, the accumulated interest portion of college endowment is thus accounted for:

In land under lease, 8 per cent	$ 5,999.51
In farm mortgages, 7 per cent	81,150.00
Awaiting investment	2,530 00
Total	$ 89,679.51
Adding to this the portion of the original endowment still invested in land	46,791 94
We have the total charged to the agency	$136,471.45

My office bears to this agency a relation similar to that which it bears to the financial agency. An account is kept with each tract of land and each loan in such way as to show at all times its condition. Comparison of my books is made with those of the agent, and the accuracy of his accounts is thus thoroughly tested.

It is the purpose of the law that the secretary of the board shall stand in the relation of an accounting officer to the different officers entrusted with the management of college funds. It is believed that the system now in force provides fully for the accomplishment of this end. It greatly aids the trustees in making settlement with these officers, and it enables my office to promptly furnish to the board detailed information regarding the condition of any and all college funds.

The following is the present condition of the fund taken as a whole:

Endowment fund yielding income—		
Land under lease (including Ringgold county tract obtained under foreclosure at a cost to the endowment fund of $1,200), 12,109.17 acres, appraised at		$ 53,991.45
Farm mortgages bearing 8 per cent interest		2,450.00
Farm mortgages bearing 7 per cent interest		585,223.63
Farm mortgages bearing 6 per cent interest		5,300.00
Polk county tract of forty acres leased at $85		2,418.55
Total yielding income		$ 649,383.63
Not yielding income—		
Cash balance:		
Original endowment fund	$ 29,119.89	
Accumulated interest	2,530.00	
Total		31,649.89
Total endowment		$ 681,033 52

The large uninvested balance on hand is due to the fact that loans bearing 7 per cent interest can not be readily made.

INCOME OF THE COLLEGE AND COST OF MAINTENANCE.

The following are the sources of the college income:

1. National fund for maintaining the college.
2. The national fund for maintaining the experiment station.
3. The appropriations by the state for buildings and repairs

4. Rental of rooms, diploma fees, and rental on a tract of donated land.

Considering these in their order we have:

I. A NATIONAL FUND FOR MAINTAINING THE COLLEGE.

INCOME.

For fiscal year 1896—		
From endowment fund	$ 46,596 05	
From Morrill support fund	22,000 00	
Total		$ 68,596.05
For fiscal year 1897—		
From endowment fund	$ 47,729 75	
From Morrill support fund	15,000 00	
Total		62,729.75
Total		$ 131,325.80

EXPENDITURES.

For fiscal year 1896—		
For salaries, charged salary account	$ 34,136.11	
For apparatus, assistants and current expenses of departments	32,663.18	
Total		$ 66,799.29
For fiscal year 1897—		
For salaries, charged salary account	$ 35,591.81	
For apparatus, assistants and current expenses of departments	30,487.90	
Total		66,079.71
Total for the biennial period		$ 132,879.00

The foregoing statement shows that the expenditures on account of these national support funds during the biennial period exceeded the amount received therefrom by the college treasurer in the sum of $1,553.20, thus reducing the balance in his hands to the credit of these funds, from $14,470.70 to $12,917.50. It should, however, be noted in this connection that $8,000 of the Morrill fund of 1897 has not been drawn from the state treasurer and does not therefore appear in this account.

II. NATIONAL EXPERIMENT STATION FUND.

INCOME.

From national appropriation for 1896	$ 15,000.00
From national appropriation for 1897	15,000.00
Total	$ 30,000.00

EXPENDITURES.

For 1896, over and above income from sales	$ 14,088.25
For 1897, over and above income from sales	16,203.89
Total	$ 30,292.14

This shows an excess of expenditures over income of $292.14, thus reducing the cash balance of $313.95 to the credit of the station at the beginning of the biennial period to the present balance of $21.81.

III. STATE BUILDING, IMPROVEMENT AND REPAIR FUNDS.

RECEIPTS FROM APPROPRIATIONS.

Drawn from the state treasury during 1896	$ 36,912.63
Drawn from the state treasury during 1897	37,232.10
Total	$ 74,144.73

EXPENDED.

During 1896	$ 36,435.84
During 1897	37,692.88
Total	$ 74,128.72
Balance in hands of college treasurer	16.01
Total	$ 74,144.73

IV. MISCELLANEOUS ITEMS.

RECEIPTS.

For fiscal year 1896—		
Rent on donated land	$ 3.20	
Rent of rooms to students and instructors	1,966.55	
Diploma fees	327.00	
Total		$ 2,296.75
For fiscal year 1897—		
Rent on donated land	3.20	
Rent of rooms to students and instructors	2,008.53	
Diploma fees	275.00	
Total		2,286.73
Total		4,583.48

EXPENDITURES.

For fiscal year 1896—		
In repairing and furnishing dormitory buildings and rooms	$ 2,334.39	
On diploma account	80.50	
Total		$ 2,414.89
For fiscal year 1897—		
In repairing and furnishing dormitory buildings and rooms	$ 1,686.46	
On diploma account	313.30	
Total		1,999.76
Total		$ 4,414.65

The foregoing statement shows that the receipts on account of these miscellaneous items exceeded the expenditures by $168.83, thus increasing the balances to their credit from $1,116.08 to $1,284.91.

In making up my account with the college treasurer, he is debited with the income as set forth in the foregoing statements, and is credited with the sums expended as shown in these same exhibits. There also appears on each side of his account an amount equal to the aggregate of the sales of the several departments, since the proceeds of such sales are paid into the treasury and are afterwards expended by the respective departments to meet current expenses.

The principal of accumulated interest loans, when collected, is paid to the treasurer and charged to his account, while he is credited with the amount of such funds drawn out for the purpose of making loans. These items, together with the cash balance at the beginning of the year, make up the totals with which he is debited and credited.

Putting this data in shape for ready reference and comparison, my account with the college treasurer shows the following receipts and expenditures for the two years of the biennial period:

ACCOUNT WITH THE COLLEGE TREASURER.

RECEIPTS FOR 1896.

Cash balance on hand at the beginning of the year		$ 17,318.78
Income available for current expenses, experimentation and improvements:		
National fund for maintaining the college	$ 68,596.05	
National fund for maintaining the experiment station	15,000.00	
State appropriations for buildings, repairs, improvements and current expenses	36,912.63	
Miscellaneous items, as explained	2,296.75	
Total		122,805.43

Receipts from sales of departments afterwards used by these departments:		
Experiment station	$ 3,308.03	
Creamery	18,795.82	
Other departments	12,164.08	
Total		34,267.93
Accumulated interest fund paid in to be reinvested		15,750.00
Total charged against the treasurer for 1896		$ 190,142.09

DISBURSEMENTS FOR 1896.

For maintenance of college in its departments of instruction	$ 66,799.29	
For maintenance of experiment station	14,088.25	$ 80,887.54
Total		
From state funds for the purposes specified in the appropriations		36,435.84
From student funds for repairing dormitory buildings and rooms, and purchasing diplomas		2,414.89
Cost of maintenance, experimentation and improvements for the year.		$ 119,738 27
Department sales expended		34,267.93
Accumulated interest fund reinvested		17,100.00
Total disbursements		$ 171,106.20
Cash balance on hand		19,035.89
Total		$ 190,142.09

RECEIPTS FOR 1897.

Cash balance on hand at the beginning of the year		$ 19,035.89
Income available for current expenses, experimentation and improvements:		
National fund for maintenance of college	$ 62,729.75	
National fund for maintenance of experiment station	15,000.00	
State appropriations for buildings, repairs, improvements and current expenses	37,232.10	
Miscellaneous items as explained	2,286.73	
Total		117,248 58
Receipts from sales of departments afterwards used by these departments:		
Experiment station	$ 3,203.36	
Creamery	20,486.42	
Other departments	13,520.98	
Total		37,210.76
Principal of loans paid in to be reinvested		9,900.00
Total charged against the treasurer for 1897		$ 183,395.23

DISBURSEMENTS FOR 1897.

For maintenance of college in its departments of instruction	$ 66,079.71	
For maintenance of experiment station	16,203 89	
Total		82,283.60
From state funds for the purposes specified in the appropriations.		37,692.88
From student funds for repairing dormitory buildings, rooms and purchasing diplomas		1,999.76
Cost of maintenance, experimentation and improvements for the year.		121,976.24
Department sales expended		37,210.76
Accumulated interest fund reinvested		7,350.00
Total disbursements		$ 166,537.00
Cash balance on hand		16,858 23
Total		$ 183,395.23

The methods of testing the accounts with the college treasurer and other officials handling the college income are such as would seem to insure accuracy. The state treasurer and Agent Knapp make monthly reports to my office of interest and rental collected. The account kept by me with each loan and lease would show any failure on their part to account for interest or rental due. The amounts collected are paid to the college treasurer monthly and, as in the case of all other moneys received by him, he issues therefor receipts in duplicate, the original of which is countersigned by me and the duplicate filed in my office. In the matter of the annual appropriations of the national government, not only are the accounts chargeable to the college treasurer certified to by the duplicate receipts, but these appropriations are definite in amount and payable at particular dates. State appropriations are drawn only on requisitions signed by the chairman and secretary of the board of trustees. Itemized statements of room rent and fees collected are filed in my office by the heads of the different departments. These, with the inventories filed and the treasurer's vouchers, render it possible not only to trace each article from its purchase to its sale or use, but also, by comparisons easily made, to test the accuracy of the account kept with the treasurer. By the ways thus briefly reviewed the items charged against this officer are determined.

The treasurer is credited with all bills paid by him. These must, prior to payment, be approved by the board of audit, which consists of the president of the college and the secretary of the board of trustees. It is a condition, precedent to such approval, that the correctness of the bill shall be certified to by the head of the department purchasing the supplies or employing the labor; nor will the bill be allowed if in excess of the appropriation made to such department. Bills relating to the erection, repair and improvement of buildings and the purchase of furniture are, before audit, approved by the chairman of the building committee of the board, and no bill in favor of a salaried officer of the institution is allowed until it has been passed upon by the board in regular session. All bills must be fully itemized, constitute a just claim against the institution, and be legally payable from the fund against which they are audited.

At the time of audit each bill is charged upon my books to the proper state or department appropriation; it also appears as a credit to the treasurer. My books are compared monthly with the treasurer's accounts; and the two brought to agree. At the close of each fiscal year a settlement sheet with the treasurer is prepared from my books, which shows on the one hand the items of cash with which he is debited, and on the other the amount of the bills paid by him on each of the state appropriations and department accounts. The committee of the board of trustees appointed each year to make settlement with the treasurer checks these items of cash received with the duplicate receipts filed in my office, and, reviewing the additions, thus determines the amount with which he should be debited. This committee also compares the vouchers of the treasurer with the items which make up the expenditures under the different accounts, and then adding the columns of his ledger, compares the result with the amounts with which I have credited him on the balance sheet. These agreeing, the amounts are then added and the total with which the treasurer should be credited ascertained. This settlement is carried forward by the committee to the time of the approval of the treasurer's annual bond of $50,000 by the secretary of state. The cash balance as determined at that time is produced by the treasurer and counted by the committee.

Careful attention is called to the accounting machinery thus described. It represents the development of many years, has been adjusted to the peculiar demands of the institution in its relations to the state and national governments, and would appear to fully protect and conserve the public interests. It is confidently submitted as a system under which the board of trustees, a committee of the legislature, or any citizen of the state can readily gain full information regarding the financial management of the institution.

As shown in the account with the treasurer, there was in his hands at the close of the fiscal year, of the college funds proper, a balance of $16,858.23. This amount is to the credit of the following funds:

College support funds—		
Interest fund	$ 3,927 62	
Morrill fund	8,989 88	
Total		$ 12,917.50
Experiment station fund		21.81
State appropriations		16 01
Donation fund		9 60
Right of way damages		88.00
Accumulated interest awaiting investment		2,530.00
Student funds—		
Room rent	$ 370 98	
Diploma fund	904 33	
Total		1,275 31
Total		$ 16,858 23

The annual appropriation of the national government, known as the Morrill fund, is payable shortly after the beginning of the government fiscal year. The balance to the credit of the support funds is generally quite small toward the close of the government year, and care is necessary in making the department appropriations to provide for their expenditure at such times as will not embarrass the college financially. I estimate the support funds for the coming year available for department appropriations at $69,000. There is attached to this report the usual exhibits showing the income of the educational support funds for each of the two years and their expenditure for departmental purposes. In another place in the biennial report, under the head of "State Appropriations," all of the funds derived from the state will be treated in detail. A presentation of the financial condition of the experiment station will be included in the abstract of the proceedings of the board of trustees. Respectfully submitted,

E. W. STANTON,
Secretary.

EXHIBIT "A."

The following shows the ordinary income of the college support funds for the fiscal year ending November 11, 1896, together with the expenditures on account of the various departments:

RECEIPTS.

Cash balance on hand November 14, 1895		$ 14,470.70
Rental on endowment fund land	$ 5,246 51	
Rental on land purchased with interest fund	861.95	
Interest on endowment fund invested in farm mortgages, bonds, and state warrants	34,952.11	
Rental on land obtained by the foreclosure of endowment fund mortgages	211.00	
Interest on interest fund invested in farm mortgages	5,324 48	
Total		46,596.05
Morrill support fund—installment for 1896		2,000 002
Total		$ 83,066.75

EXPENDITURES.

Salaries—		
Morrill fund	$ 13,728.18	
Interest fund	20,407 93	$34,136.11
Agricultural department—		
Current expenses	$ 1,395.05	
Foreman	550.00	
Permanent improvements	82.92	
Class expenses	97.79	2,125.76
Creamery credit		1,032.65
Dairy—		
Salary of G. L. McKay		1,200.00
Apparatus and current expenses (Cr. $142.94).		
Horticultural department—		
Current expenses and experimentation	$ 648 76	
Assistant	383 29	1,032 05
Veterinary department—		
House surgeon	$ 200.00	
Current expenses and apparatus	347 51	547.51
Pathological department—		
Current expenses and apparatus	$ 79.82	
Microscope and rental	125 00	204.82
Mechanical department—		
Assistants	$ 2,900.00	
Current expenses and equipment.,	1,875.00	
Nonresident lecturer	50.00	4,825.00
Civil engineering—		
Assistant	$ 300.00	
Current expenses and equipment	599.93	
Nonresident lecturer	30 00	929 93
Physics and electrical engineering—		
Current expenses and apparatus		1,117.85
Mining engineering		686.71
Military tactics and physical culture—		
Current expenses and flags	$ 222.97	
Flag and flag staff	94.40	317.37
Department of chemistry—		
Assistants	$ 925.00	
Current expenses and apparatus	552.13	1,477.13
Agricultural chemistry—		
Assistant	$ 113.19	
Current expenses and apparatus	394.12	507.31
Entomology and zoology—		
Assistant	$ 248.72	
Current expenses and apparatus	604.74	853.46
Botany—		
Assistants	$ 300.00	
Current expenses and apparatus	298.96	598.96
Mathematics and secretary's office—		
Assistants and clerk hire		1,461.77
Domestic economy		260.01
Department of music—		
Salary of director	$400 00	
Instrumental music, public exercises	100.00	
Current expenses	37.90	537.90

Library—		
Librarian	$ 566.92	
Assistant	150.00	
Expenses, books and periodicals	1,869.00	$ 2,585.92
Public grounds		1,192.85
Sabbath services		474.80
Public rooms—		
Furniture	$ 535.10	
Heating, lighting and janitor service	3,350 00	3,885.10
Contingent expense		4,951.76
Total		$ 66,942.23
Less dairy credit		142.94
Total net ordinary expenses		$ 66,799.29
Cash on hand—		
Morrill fund	$ 15,962.93	
Interest fund	304.53	16,267.46
Total		
Total		$ 83,066 75

EXHIBIT "B."

The following shows the ordinary income of the college from the national support funds for the fiscal year ending November 10, 1897, together with the expenditures on account of the various departments:

RECEIPTS.

Cash balance on hand November 12, 1896		$ 16,267.46
Rental on endowment fund land	$ 3,935.52	
Rental on land purchased with interest fund	607 95	
Interest on endowment fund invested in farm mortgages	38,245.31	
Rental on land obtained by the foreclosure of endowment fund mortgages	168.50	
Interest on interest fund invested in farm mortgages	4,742.47	47,729.75
Total		
Morrill support fund—part of installment for 1897		15,000 00
Total		$ 78,997.21

EXPENDITURES.

Salaries—		
Morrill fund	$ 21,973.05	
Interest fund	13,618.70	35,591.81
Agricultural department—		
Current expenses	$ 1,301.75	
Foreman	600.00	
Permanent improvements	341.63	
Class expenses	140.00	
Wilcox suit	216.39	2,599.77
Creamery credit		1,192.06
Dairy—		
Salary of G. L. McKay		1,200.00
Apparatus and current expenses	$ 132.20	
Horticultural department—		
Current expenses and experimentation	837.35	
Assistant	399.97	1,237.32
Veterinary department—		
House surgeon	$ 200.00	
Current expenses and apparatus	303.58	503.58

Pathological department—Current expenses and apparatus		$ 64.43
Mechanical department—		
Assistants	$ 2,900.00	
Current expenses and equipment	1,679.09	4,579.09
Civil engineering—		
Assistants	$ 300.00	
Current expenses and equipment	793.95	1,093.95
Physics and electrical engineering—Current expenses and apparatus		765.90
Mining engineering		93.74
Military tactics and physical culture—Current expenses and flags		196.83
Department of chemistry—		
Assistants	$ 925.00	
Current expenses and apparatus	631.16	1,556.16
Agricultural chemistry—		
Assistant	$ 100.00	
Current expenses and apparatus	400.81	500.81
Entomology and zoology—Current expenses and apparatus		618.14
Botany—		
Assistants	$ 350.00	
Current expenses and apparatus	299.61	649.61
Mathematics and secretary's office—Assistants and clerk hire		1,450 00
Domestic economy		314.24
Department of music—		
Salary of director	$ 400.00	
Instrumental music, public exercises	100.00	
Current expenses	28.82	528.82
Library—		
Librarian	$ 600.00	
Assistants	150.00	
Expenses, books and periodicals	1,750 58	2,500.58
Public grounds		1,287.64
Sabbath services		429.15
Public rooms—		
Furniture	$ 74.86	
Heating, lighting and janitor service	2,625.30	2,700 19
Contingent expense		4,558.12
Total		$ 66,211.91
Less dairy credit		132.20
Total net ordinary expenses		$ 66,079.71
Cash on hand—		
Morrill fund	$ 8,989.88	
Interest fund	3,927 62	12,917.50
Total		$78,997.21

EXHIBIT "C."

The following statement shows for the fiscal year ending Nov. 10, 1897—

1. Total expenditures of each department.
2. Total income of each department.
3. Total amount of interest fund expended by each department.
4. Appropriation by the board to each department.

ACCOUNT.	Total amount expended.	Total income, sales, etc.	Amount of appropriation expended.	Amount of appropriation.
Salaries	$ 35,591.81	....	$35,591.81	$35,591.81
Agricultural department—				
Current expenses	7,529.35	$ 6,227.60	1,301.75	1,400.00
Foreman	600.00	......	600.00	600 00
Permanent improvements	389.63	48.00	341.63	350.00
Class expenses	140.00	.. ..	140 00	140 00
Wilcox suit	216 39	....	216 39	216.39
Creamery credit	21,678 48	20,486.42	1,192.06	1,200.00
Dairy—				
Apparatus and current expenses	549.40	681.60	....	....
Salary of G. L. McKay	1,200.00	....	1,200.00	1,200 00
Horticultural department—				
Assistant	399.97	. . ..	399 97	400.00
Current expenses and apparatus	2,192.14	1.354.79	837.35	850 00
Veterinary department—				
House surgeon	200 00	....	200 00	200.00
Current expenses and apparatus	488.58	185.00	303.58	350.00
Mechanical department—				
Assistants	2,900.00	.. ..	2,900.00	2,900.00
Current expenses and equipments	3,978.53	2,299.44	1,679 09	1,700 00
Civil engineering—				
Assistant	300 00	....	300.00	300.00
Current expenses and equipment	883.73	89.78	793 95	800.00
Physics and electrical engineering—				
Current expenses and apparatus	1,098.52	332.62	765 90	925.00
Mining engineering	93 74	....	93.74	200 00
Military tactics and physical culture—				
Current expenses	196 83	....	196.83	200.00
Agricultural chemistry—				
Assistant	100.00	......	100 00	100.06
Current expenses and apparatus	834.60	433.79	400.81	400.81
Department of chemistry—				
Assistants	925.00	......	925.00	925.00
Current expenses and apparatus	1,889.16	1,258.00	631.16	795.00
Entomology and zoology—				
Current expenses and apparatus	793.60	175.46	618.14	625.00
Pathological department—				
Current expenses and apparatus	74.93	10.50	64.43	100.00
Botany—				
Assistants	350.00	.. ...	350.00	350.00
Current expenses and apparatus	460.06	160.45	299.61	300 00
Mathematics and secretary's office—				
Assistants and clerk hire	1,450.00	....	1,450.00	1,450 00
Domestic economy	544.84	230.60	314.24	325.00
Department of music—				
Salary of director	400.00	....	400.00	400.00
Instrumental music, public exercises	100.00	....	100.00	100 00
Current expenses	28.82	....	28 82	40.00
Library—				
Librarian	600.00	....	600.00	600.00
Assistant	150 00	....	150 00	150.00
Current expenses, books and periodicals	1,754.08	3.50	1,750.58	1,925 00
Sabbath services	429.15	......	429 15	450.00
Public grounds	1,317.49	29.85	1,287 64	1,300.00
Public rooms—				
Furniture	74 86	....	74 86	450.00
Heating, lighting and janitor service	2,625.30	....	2,625.30	2,700 00
Contingent expense	4,558.12	....	4,558.12	5,038 71
Total	$100,087.11	$34,007 40	$66,211.91	$68,047.72
Dairy credit balance current expense	....	....	132.20	.. ..
			$66,079 71	

TREASURER'S REPORT.

The following is a complete statement of the transactions in all the accounts for the fiscal year ending November 11, 1896.

	BALANCES NOVEMBER 14, 1895.		FISCAL YEAR.		TOTAL.		INTEREST FUND.		MORRILL SUPPORT FUND.		BALANCES NOVEMBER 11, 1896.	
	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.
Int. on lands belonging to cong. gt.		$ 1,154.04		$ 5,246.51		$ 6,400 55		$ 6,400.55				
Interest on accumulated interest				6,186.43		6,186 48		6,186 43				
Int. on investm't of endowm't fund				34,952 11		34,952 11		34,9 2.11				
Int. on lands obtained by forecl're				211.00		211.00		211 00				
Contingent principal fund		83,680 00				83,680 00						$ 83,680 00
Mortgages receivable	$ 82,350.00		$ 17,100 00	15,750.00	$ 99,450.00	15,750.00					$ 83,700 00	
Donation fund		3 20		3.20		6.40						6 40
Diploma fund		696 13	80 50	327.00	80.50	1,023.13						942.63
Room rent		416 75	2,334.39	1,066 55	2,334.39	2,383.30						48 91
Railroad damages		88.00				88 00						88 00
Personal accounts	476.95				476 95						476.95	
Bills receivable	577 25				577.25						577.25	
Morrill support fund—salaries		14,370.86	20.407.93	22.000.00	20,407.93	36,370 86				$15,962 93		
Experiment station—1895-1896		313.95	10,640 19	10,326.24	10,640 19	10,640 19						
Experiment station—1896-1897			6,756 09	7,981 79	6,756 09	7,981.79						1,225.70
Salaries			13,728 18		13,728 18		$13,728.18					
Farm department			4.776.12	2.650 36	4,776 12	2,650.36	2,125.76					
Creamery			19,828 47	18,795.82	19,828 47	18,795.82	1,032 65					
Dairy			1,647 06	590 00	1,647.06	590 00	1,057.06					
Horticulture			3,658 16	2,626 11	3,658.16	2.626.11	1,032 05					
Chemistry			2,575 61	1,098 48	2,575 61	1,098 48	1,477.13					
Civil engineering			962.90	32.97	962 90	32.97	929.93					
Zoology and entomology			1,071 05	217.59	1.071 05	217.59	853.46					
Mechanical			8,388 63	3,563 63	8,388 63	3,563 63	4,825.00					
Physical department			1,626.42	509 07	1,626.42	509.07	1,117.35					
Veterinary department			642.11	94 60	642.11	94.60	547.51					
Botanical department			725 96	127.00	725 96	127.00	598 96					
Department of music			537.90		537 90		537.90					
Public rooms			3,885.10		3,885.10		3,885 10					
Contingent expense			4,951 76		4,951.76		4,951 76					
Library			2.585.92		2,585.92		2,585.92					
Domestic economy			431 46	171 45	431 46	171 45	260.01					
Mathematics			1,461.77		1,461 77		1,461.77					
Military			317 37		317 37		317.37					
Mining engineering			686.71		686.71		686.71					

TREASURER'S REPORT—CONTINUED.

	BALANCE NOVEMBER 14, 1895.		FISCAL YEAR.		TOTAL.		INTEREST FUND.		MORRILL SUPPORT FUND.		BALANCES NOVEMBER 11, 1896.	
	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.
Agricultural chemistry.			923.80	416.49	923 80	416 49	507 31					
Public grounds			1.253 18	60 33	1,253 18	60.33	1.192 85					
Sabbath services			474 80		474 80		474 80					
Pathology			210 82	6 00	210.82	6 00	204 82					
State appropriations			36,435 84	36,912.63	36,435.84	36,912 63						476.79
Total	$ 83,404 20	$100,722 90	$171,106 20	$172,823.36	$254,510 40	$273,546.29	$46,391 36	$47,750 09		$15,962.93		
Balance interest fund on hand							1,358 73					$ 1,358.73
Bal. Morrill support fund on hand									$15,962.93			15,962 93
Cash to balance—												
Experiment station	313 95		911 75		1,225 70						$ 1,225 70	
State appropriations			476 79		476 79						476.79	
Morrill support fund	14,370 86		1,592 07		15,962 93						15,962 93	
Other sources	2.633.92			1,263.45	1,370.47						1,370.47	
Total	$100,722 93	$100.722 93	$174.086 81	$174.086 81	$273,546.29	$273,546 29	$47,750 09	$47,750 09	$15,962.93	$15,962 93	$103,790.09	$103,790.09

TREASURER'S REPORT—STEWARD'S DIVISION.

	BALANCES NOVEMBER 14, 1895.		FISCAL YEAR		TOTAL.		BALANCES NOVEMBER 11, 1896.	
	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.
Boarding department	$ 19.23		$ 20,736 96	$ 20,930.09	$ 20,756.19	$ 20,980.09		$ 223 90
Damages		$ 114 20	43.00	98.15	43.00	212.35		169 35
Hospital		295.18	842.30	760.55	842.30	1,055.73		213 43
Fires, lights and incidentals	1.70		14,353 25	14,365.03	14,354.95	14,365.03		10.08
Cash to balance	388 45		228 31		616 76		$ 616 76	
Total	$ 409 38	$ 409 38	$ 36,203 82	$ 36,203.82	$ 36,613.20	$ 36,613.20	$ 616.76	$ 616.76

TREASURER'S REPORT—CONTINUED.

The following is a complete statement of the transactions in all the accounts for the fiscal year ending November 10, 1897.

	BALANCES NOVEMBER 12, 1896.		FISCAL YEAR.		TOTALS.		INTEREST FUND.		MORRILL SUPPORT FUND.		BALANCES NOVEMBER 10, 1897.	
	Debit.	Credit.	Debit.	Credit.	Debit.	Debit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.
Int. on lands belonging to cong. gr.		$ 1,358.73		$ 3,965.52		$ 5,324 25		$ 5,324.25				
Interest on accumulated interest				5,350.42		5,350 42		5,350 42				
Int on investm't of endowm't fund				38,245 31		38,245.31		38,245 31				
Int. on lands obtained by foreclo're				168 50		168.50		168.50				
Contingent principal fund		83,680.00				83,680 00						$ 83,680.00
Mortgages receivable	$ 83,700.00		$ 7,350.00	9,900.00	$ 91,050 00	9,900 00					$ 81,150.00	
Donation fund		6 40		3.20		9 60						9 60
Diploma fund		942 63	313.30	275.00	313 30	1,217.63						904.33
Room rent		48.91	1,686.46	2,008.53	1,686.46	2,057.44						370 98
Railroad damages		88.00				88.00						88.00
Personal accounts	476.95				476 95						476 95	
Bills receivable	577.25				577.25						577.25	
Morrill support fund—salaries		15,962 93	21,973 05	15,000.00	21,973.05	30,962 93				$ 8,989.88		
Experiment station 1896-1897		1,225 70	10,621 56	9,395.86	10.621 56	10,621.56						
Experiment station 1897-1898			8,785 69	8,807 50	8,785 69	8,807 50						21.81
Salaries			13,618.76		13,618.76		$13,618.76					
Farm department			8,875 37	6,275.60	8,875.37	6,275.60	2,599.77					
Creamery			21,678 48	20,486 42	21,678.48	20,486.42	1,192.06					
Dairy			1,749.40	681.60	1,749 40	681 60	1,067 80					
Horticulture			2,592 11	1,354.79	2,592 11	1,354 79	1,237.32					
Chemistry			2,814 16	1,258 00	2,814.16	1,258 00	1,556 16					
Civil engineering			1,183 73	89.78	1,183.73	89 78	1,093 95					
Entomology and zoology			793 60	175 46	793 60	175 46	618 14					
Mechanical engineering			6,878 53	2,299.44	6,878 53	2,299 44	4,579.09					
Physical department			1,098 52	332.62	1,098 52	332 62	765 90					
Veterinary department			688 58	185.00	688 58	185 00	503 58					
Botany department			810 06	160.45	810.06	160 45	649 61					
Music department			528 82		528.82		528 82					
Public rooms			2,700 16		2,700 16		2,701.16					
Contingent expense			4,558 12		4,558.12		4,558 12					
Library			2,504.08	3.50	2,504 08	3.50	2,500 58					
Domestic economy			544.84	230 60	544.84	230.60	314.24					
Mathematical department			1,450 00		1,450 00		1,450 00					
Military department			196 83		196 83		196 83					
Mining engineering			93 74		93.74		93.74					

TREASURER'S REPORT—CONTINUED.

	BALANCES NOVEMBER 12, 1896.		FISCAL YEAR.		TOTAL.		INTEREST FUND.		MORRILL SUPPORT FUND.		BALANCES NOVEMBER 10, 1897.	
	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.
Agricultural chemistry			934 60	433 79	934 60	433 79	500.81					
Public grounds			1,317.49	29.85	1,317 49	29 85	1,287.64					
Sabbath services			429.15		429.15		429.15					
Pathology			74.93	10.50	74 93	10 50	64 43					
State appropriations		476 79	37,694.88	37,232.10	37,692 88	37,708.89						16.01
Total	$ 84,754.20	$103,790.09	$166,537.00	$164,359.34	$251,291 20	$268,149.43	$44,106.66	$49,088.48		$ 8,989.88		
Balance interest fund on hand							4,981.82					$ 4,981 82
Bal. Morrill support fund on hand									$ 8,989 88			8,989 88
Cash to balance—												
Experiment station	1,225.70			1,203.89	21.81						$ 21 81	
State appropriations	476 79			460 78	16 01						16.01	
Morrill support	15,962.93			6,975.05	8,989 88						8,989 88	
Other sources	1,370.47		6,460 06		7,830 53						7,830 53	
Total	$103,790.09	$103,790.09	$172,997 06	$172,997.06	$258,149 43	$268,149 43	$49,088 48	$49,088 48	$ 8,989 88	$ 8,989 88	$ 99,062.43	$ 99,062 43

TREASURER'S REPORT—STEWARD'S DIVISION.

	BALANCES NOVEMBER 12, 1896.		FISCAL YEAR.		TOTALS.		BALANCES NOVEMBER 10, 1897.	
	Debit.	Credit.	Debit.	Debit.	Debit.	Credit.	Debit.	Credit.
Boarding department		$ 223.90	$ 21,349 56	$ 21,683.18	$ 21,349.56	$ 21,907.08		$ 557 52
Damages		169.35		72 64		241 99		241 99
Hospital		213 43	638.18	724 60	638 18	938 03		299.85
Fires, lights and incidentals		10.08	13,183 04	13,172 96	13,183 04	13,183.04		
Piano rent			30.50	32.00	30 50	32.00		1.50
F. J Resler			732.10	746.10	732 10	746 10		14.00
A. M. Newens			336.45	336.45	336 45	336.45		
Cash to balance	$ 616.76		498.10		1,114.86		$ 1,114.83	
Total	$ 616.76	$ 616.76	$ 36,767.93	$ 36,767.93	$ 37,384.69	$ 37,384.69	$ 1,114.86	$ 1,114.86

STATE APPROPRIATIONS.

The following is a statement of the different appropriations for the biennial period ending November 10, 1897:

	Drawn from state treasurer.	Expended.	Balance November 10, 1897.
State repair and improvement fund of 1896	$ 910.06	$ 910.06	....
State contingent fund of 1896	973 25	973.25	....
State experimental fund of 1895, 1896 and 1897	4,460.79	4,452.39	$ 8.40
Improvements and current expenses	24,182 87	24,175.36	7.51
Deep well	14,066.37	14,066.37	....
Waterworks	17,678.65	17,678.65	....
Greenhouse	6,000.00	6,000.00	....
Forge shop	1,831.41	1,831.41	....
Remodeling farm barns	3,996.78	3,996.68	.10
Sewage disposal system	44.55	44.55	....
Total	$ 74.144 73	$ 74,128.72	$ 16.01

MORRILL FUND.

The following is a summary of the report made to the secretary of the interior for the year ending June 30, 1896:

RECEIPTS.

July 1, 1895. Balance on hand		$ 3,233.32
July 10, 1895. Received from state treasurer		21,000.00
Total		$ 24,233.32

EXPENDITURES.

Paid for agricultural instruction	$ 5,749.92	
Paid for mechanic arts instruction	5,566.03	
Paid for mathematical science instruction	1,066.64	
Paid for natural and physical science instruction	7,895.99	
Paid for economic science instruction	533.32	
Total		$ 20,811.90
Balance cash on hand June 30, 1896		3,421.42
Total		$ 24,233.32

The following is a summary of the report made to the secretary of the interior for the year ending June 30, 1897:

RECEIPTS.

July 1, 1896. Balance on hand		$ 3,421.42
August 6, 1896. Received from the state treasurer		22,000.00
Total		$ 25.421.42

EXPENDITURES.

Paid for agricultural instruction	$ 5,824.89	
Paid for mechanic arts instruction	4,949.88	
Paid for English language instruction	150.00	
Paid for mathematical instruction	1,066.64	
Paid for natural and physical science instruction	8,999.88	
Paid for economic science instruction	533.32	
Total		$ 21,524.61
Balance on hand June 30, 1897		3,896 81
Total		$ 25,421.42

Respectfully submitted,

HERMAN KNAPP
Treasurer.

REPORT OF LAND AGENT.

To the Board of Trustees of the Iowa Agricultural College and Farm:

The following report of the transactions of the land department of the Iowa State Agricultural college from November 1, 1895, to October 31, 1896, inclusive, is hereby submitted:

COLLECTIONS.

Interest or rent on lands belonging to the congressional grant	$ 5,246.51	
Interest or rent on lands purchased with accumulated interest	479.95	
Interest or rent on lands obtained by foreclosure of loans made from endowment fund	126.00	
Interest on loans made from accumulated interest	5,706.48	
Total income collected during fiscal year		$ 11,558.94
Sale of lands belonging to congressional grant	$ 18,997.43	
Principal on loans made from accumulated interest	15,750.00	
Total principal collected during fiscal year		34,747.43
Total collections		$ 46,367.30

DISBURSEMENTS.

Paid college treasurer as follows:

Interest or rent on lands belonging to the congressional grant	$ 5,246.51	
Interest or rent on lands purchased with accumulated interest	479.95	
Interest or rent on lands obtained by foreclosure of loans made from endowment fund	126.00	
Interest on loans made from accumulated interest	5,706.48	
Principal on loans made from accumulated interest	15,750.00	
Total paid college treasurer for fiscal year		$ 27,308.94
Remitted state treasurer as follows:		
Sale of lands belonging to congressional grant		18,997.43
Total disbursements		$ 46,306.37

LOANS.

Loan No. 130.	Caroline Jakobsen	$ 2,000.00	
Loan No. 131.	Christine Erickson	800.00	
Loan No. 132.	L. K. Anderson	1,100.00	
Loan No. 133.	Ole T. Eames	2,000 00	
Loan No. 134.	John J. Griffin	2,000.00	
Loan No. 135.	Marilla McKimm	1,500 00	
Loan No. 136.	Mrs. M. M. Adamson	1,200.00	
Loan No. 137.	Ole K. Grane	1,500.00	
Loan No. 138.	Dorthea Havnen	2,000.00	
Loan No. 139.	Christ. O. Mehl	1,200.00	
Loan No. 140.	Fred J. Schuver	900.00	
Loan No. 141.	Gustov Raake	900,00	
Total loaned from November 1, 1895, to October 31, 1896, inclusive			$ 17,100.00
Amount of loans outstanding November 1, 1895			82,350.00
Total			$ 99,450 00
Amount of principal paid from November 1, 1895, to October 31, 1896			15,750.00
Total of loans outstanding			$ 83,700.00

Number of acres of congressional grant patented since last report, 5,712.34; value of same, $18,997.43.

Respectfully submitted,

HERMAN KNAPP,
Agent.

LIST OF RENEWED LEASES.

64 se. Humboldt, 4-93-27-160, $2.50, $400, D. Marty, September 4, 1895, 5; 8 per cent.
1011 ne. Clay, 17-94-36-160, $3 $480, W. E. Brown, December 31, 1894, 5; 8 per cent.
1067 ne. Lyon, 31-98-48-160, $2.25, $360, D. J. Carpenter, September 18, 1894, 5; 8 per cent.
1068 nw. Lyon, 31-98-48-160, $2.25, $360, D. J. Carpenter, September 18, 1894, 5; 8 per cent.
1605 e½ of se. Kossuth, 23-97-27-80, $3, $240, A. D. Clarke, January 6, 1896, 5; 8 per cent.
1663 se. Palo Alto, 5-96-31-160, $5, $800, J. T. Ashworth, July 19, 1896, 10; 8 per cent.
1891 sw. Dickinson, 17-98-36-160, $4, $640, D. Gish, November 24, 1895, 5; 8 per cent.
1896 sw. Kossuth, 27-95-27-160, $3 50, $560, C. T. Simpson, December 31, 1896, 5; 8 per cent.
1946 sw. Kossuth, 1-98-30-160, $3.50, $560, J. B. Moulton, June 15, 1896, 5; 8 per cent.
1947 se. Kossuth, 2-98-30-160, $3.50 $560, J. N. Harris, June 15, 1896, 5; 8 per cent.
1945 se. Kossuth, 1-98-30-160, $3.50, $560, J. B. Moulton, June 15, 1896, 5; 8 per cent.
1959¼ e½ of ne. Emmet, 30-100-34-80, $4, $320, G. Petz, July 1, 1896, 5; 8 per cent.
1959½ w½ of ne. Emmet, 30-100-34-80, $4, $320, G. Petz, July 1, 1896, 5; 8 per cent.
1970 nw. se. Woodbury, 36-87-45-40, $3.75, $150, W. A. Smith, August 6, 1896, 5; 8 per cent.
Totals, 1,880 acres, $6,310.

REPORT OF LAND AGENT.

To the Board of Trustees of the Iowa State College of Agriculture and Mechanic Arts:

The following report of the transactions of the land department of the Iowa State College of Agriculture and Mechanic Arts, from November 1, 1896, to October 31, 1897, inclusive, is hereby submitted:

COLLECTIONS.

Interest or rent on lands belonging to the congressional grant		$ 3,965.52
Interest or rent on lands purchased with accumulated interest		607.95
Interest or rent on land obtained by foreclosure of loans made from endowment fund		126.00
Interest on loans made from accumulated interest		4,742.47
Total income collected during fiscal year		$ 9,441.94
Sale of lands belonging to congressional grant	$ 8,479.15	
Principal on loan made from accumulated interest	9,900.00	
Total principal collected during fiscal year		18,379.15
Total collections		$ 27,821.09

DISBURSEMENTS.

Paid college treasurer as follows:	
Interest or rent on lands belonging to the congressional grant	$ 3,965.52
Interest or rent on lands purchased with accumulated interest	607.95
Interest or rent on lands obtained by foreclosure of loans made from endowment fund	126.00
Interest on loans made from accumulated interest	4,742.47
Principal on loans made from accumulated interest	9,900.00
Total paid college treasurer for fiscal year	$ 19,341.94
Remitted state treasurer as follows:	
Sale of lands belonging to congressional grant	8,479.15
Total disbursements	$ 27,821.09

LOANS.

There has been loaned of the contingent fund principal since the date of the last report, $17,100 at 7 per cent, secured on improved farm lands.

There has been loaned of the contingent fund principal since the date of the last report, $7,350 at 7 per cent, secured on improved farming lands, as follows:

Loan No. 142.	Hattie Johnson	$ 1,000.00
Loan No. 143.	S. G. Palmer	2,000 00
Loan No. 144.	George Sorenson	1,300.00
Loan No. 145.	Irving Baldock	1,200.00
Loan No. 146.	Catherine Billings	550 00
Loan No. 147.	Celia P. Larson	1,300.00
Total loaned from November 1, 1896, to October 31, 1897, inclusive		$ 7,350.00
Amount of loans outstanding November 1, 1896		83,700.00
Total		$ 91,050.00
Amount of principal paid from November 1, 1896, to October 31, 1897		9,900.00
Total of loans outstanding		$ 81,150.00

Number of acres of congressional grant patented since last report, 2,476.60; valuation of same, $8,479.15.

Respectfully submitted,

HERMAN KNAPP,
Land Agent.

ENGINEERS REPORT ON WATERWORKS.

To the Board of Trustees of the Iowa State Agricultural College, Ames, Iowa:

GENTLEMEN—I would respectfully report as follows concerning the college waterworks, for whose construction the legislature provided in 1896:

HISTORY.

In 1893 I was instructed by your honorable body to prepare plans for a college waterworks system. On studying the situation I found that the system then existing consisted of two old pumps, of small size, delivering water to small tanks in the various buildings through lines of one and one-half to three inch wrought iron pipes. The source of supply had for several years been a spring northeast of the farm barns. The plant was capable only of supplying, between break-downs, the water absolutely required to keep the college in operation from day to day. Exposed without any protection against destruction by fire were buildings and equipment which have cost more than $500,000, and which include collections and records beyond price, because not replaceable. The buildings are of large size and are scattered over as much ground as is occupied by a good-sized village. The college uses more water, also, than any small city in this vicinity, the daily consumption being already about 30,000 gallons, with a prospective increase to 50,000 gallons in the near future.

It was apparent that the system would have to be extensive and that it must be thoroughly reliable. The fact that the college was a state institution and the largest engineering school in Iowa made it evident, also, that the works would serve as an object lesson, both to the citizens of the state and to hundreds of young engineers. Hence it was necessary to be careful to keep in accord with the best engineering practice in all particulars in the design and construction of the system.

I prepared plans for the system substantially as now completed, and these were adopted by the board of trustees in 1893. Funds for the construction were not available at that time, and it was not until 1896 that the necessary appropriation was secured from the legislature. In the meantime the necessity for the system had been demonstrated by the enforced closing of the college for two weeks in 1895 on account of lack of water, and by two or three fires, which had to be extinguished by the primitive method of carrying water in buckets.

The failure of the college spring in 1895 made it necessary to sink a deep well instead of developing the former supply as contemplated at first. In 1896 I made the modifications of the first plans rendered necessary by this fact and by the construction of Margaret hall.

At my request these plans were then submitted to Mr. Chester B. Davis, Mem. Am. Soc. C. E., consulting engineer, of Chicago, who completely approved them. To avoid interfering with my department work, as college was in session, Mr. Davis was also, at my request, employed to design the tower, and he prepared details according to my general plan previously adopted, using dimensions and calculations of stresses, and employing many details suggest by me. On account of sickness, however, Mr. Davis was unable to work up details properly. He withdrew his plans on this account and the price p viously agreed upon for them was deducted from his fee. I then, in the su mer vacation, prepared complete detailed plans, and both the general desi 'and the details of the tower as built, have been originally suggested a fully worked out by myself. The plans for the tower were examined a approved by Mr. C. W. McMeekin, Assoc. Mem. Am. Soc. C. E., chief engine Iowa Central railway, who served without pay as Mr. Davis' representative aft Mr. Davis was taken sick. It has been a source of satisfaction to me that t plans, both for the general system and for the tower and its details, which we originated and fully worked out by me, have been completely approved by th competent consulting engineers to whom they were submitted. Mr. Davis pr pared the specifications for the distribution system and Mr. McMeekin thos for the tower.

In July, 1896, the contracts for the distribution system and the foundation of the water tower were awarded to Crellin & Lovell of Des Moines, who finishe their work in November, 1896. At the same time the contract for the superstructure of the water tower was awarded to the King Bridge company of Cleveland, Ohio, who completed erection in August, 1897.

The contracts for the pumping station were let in May, 1897. Jackson & Moss of Des Moines, constructed the station, installed the pump, and laid the pipe line connecting with the distribution system. Their contract has just been completed. The pump was bought by the college from Henion & Hubbell of Chicago.

Miss Elmina Wilson has assisted in the drafting of the waterworks plans. Mr. E. C. Macy assisted in the drafting, in the surveying, and as inspector. Mr. G. M. Ashford inspected the field riveting of the tower. It gives me especial pleasure to mention the services of these three graduates of the college civil engineering department, and to commend the conscientious work of Jackson & Moss, also graduates, in executing their contract.

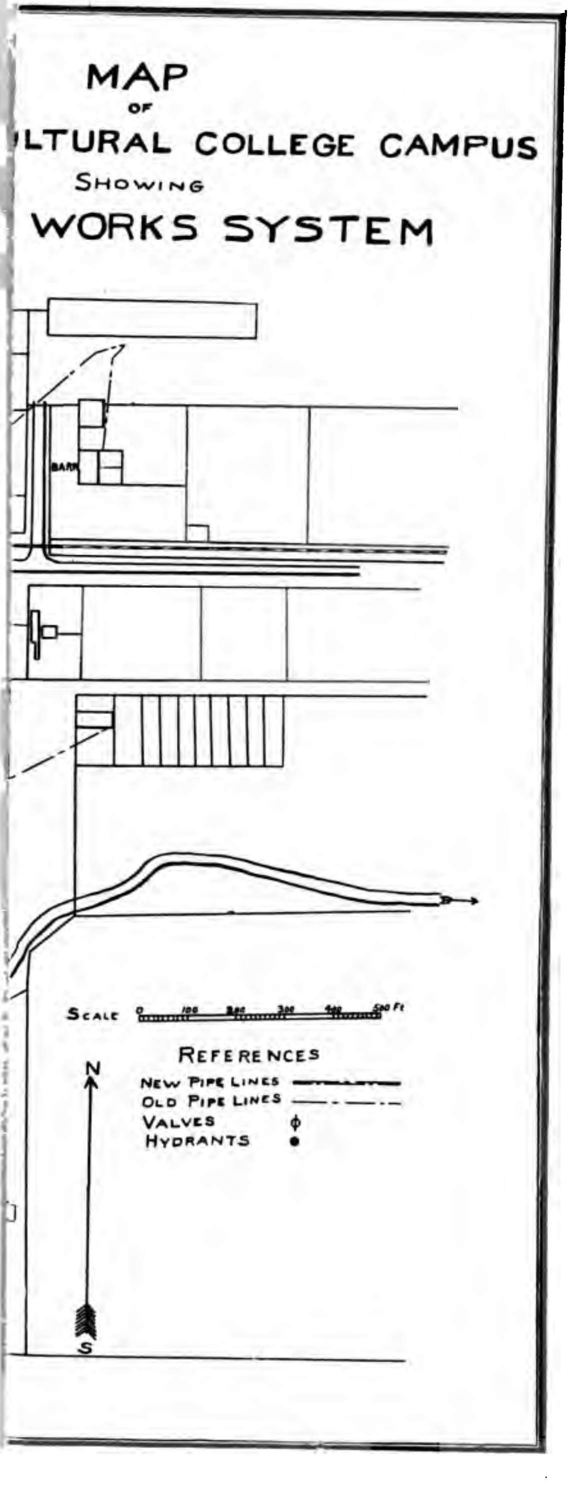
Prof. G. W. Bissell, of the college mechanical engineering department, has given much valuable advice and assistance in connection with the selection, installation and testing of the pumping plant.

The work has been executed under the direction of a committee of the board of trustees, composed of Trustees W. O. McElroy, of Newton; J. S. Jones, of Manchester; and C. F. Saylor, of Des Moines. Professor Stanton, secretary of the board, has also been very intimately connected with the work. These gentlemen have most carefully watched over the interests of the college in every feature of the work, and in so doing have faithfully executed the policy of the entire board of trustees.

DISTRIBUTION SYSTEM.

A map of the college campus showing the locations of the pipe lines, hydrants, valves, pumping station and water tower accompanies this report. By referring to this map the system will readily be understood. Attention is called to the following features:

The main eight inch pipe line makes the complete circuit of the campus. This arrangement rendered long branches to the different buildings unnecessary and avoided disfiguring the campus by ditches. Its great advantage, how-


MAP
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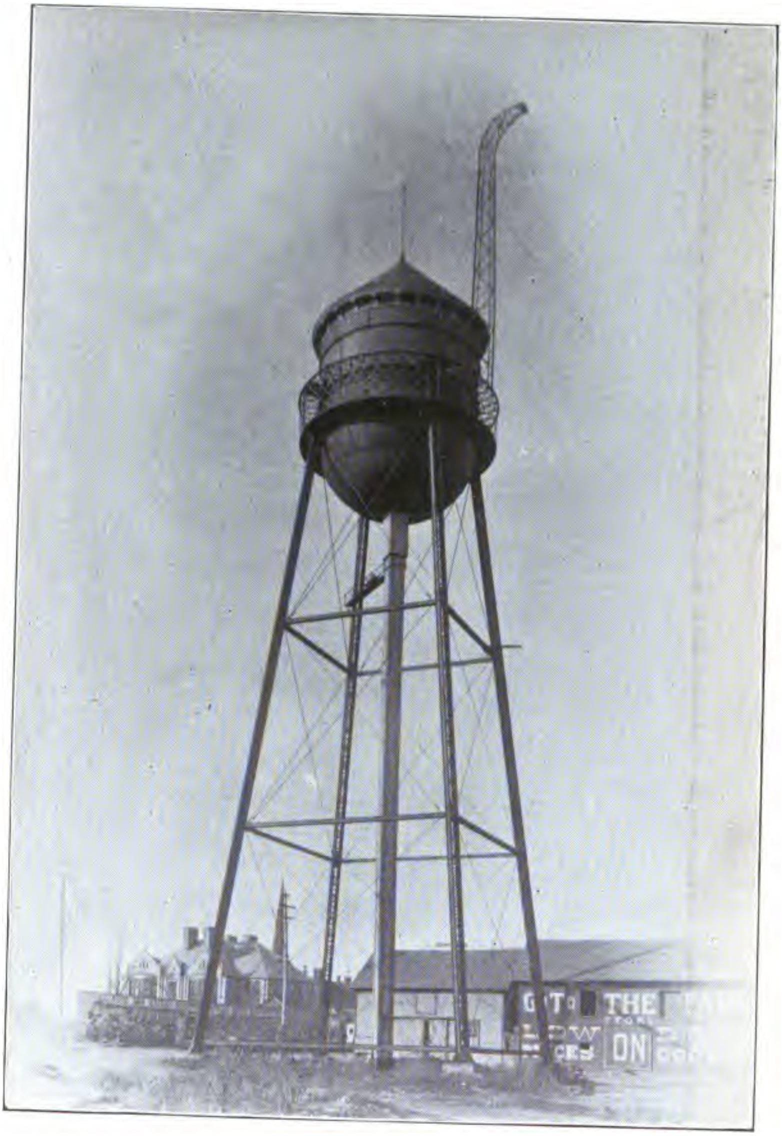


FORT DODGE, IOWA.

Height, 126 feet.

Capacity, 100,000 gallons.

ever, is that, since water can reach any point on the line by two independent routes, the capacity of the line in carrying water for fire streams is doubled, and no part of the college need be cut off from fire protection to permit repairs or extensions.

The mains are of ample size, being large enough to permit the concentration of four good hose streams on any important building.

Valves are freely used, making it unnecessary to shut off more than one short section of the pipe line at a time to permit repairs or extensions. A valve is placed between each hydrant and the main pipe line.

The hydrants have six inch inlet pipes connecting them with the mains. This is necessary to permit taking two good fire streams from a hydrant. The hydrants are so located that at least two are within easy reach of each important building.

The pipe lines were laid to regular grades, and blowoff valves emptying into drain tiles were placed at all low points on the grade line. This enables any section of the pipe line to be drained of water for repairs or making connections.

All of the above features of the system are in strict accord with good engineering practice. In all of them, however, the average city system is apt to be very deficient. Four inch street mains, four inch hydrant inlets, and the omission of valves often combine to render city waterworks of little value for fire protection.

The distribution system of the college waterworks includes, besides old pipe lines retained:

127 feet of 10-inch cast iron mains.
6034 feet of 8-inch cast iron mains.
961 feet of 6-inch cast iron mains.
181 feet of 4-inch cast iron mains.
144 feet of 3-inch galvanized wrought iron mains.
555 feet of 2-inch galvanized wrought iron mains.
17 hyrants.
1 10-inch gate valve.
12 8-inch gate valves.
18 6-inch gate valves.
3 4-inch gate valves.
4 3-inch gate valves.
18 2-inch gate valves.

WATER TOWER.

A gravity system of waterworks is more reliable than any other kind, and hydraulic engineers prefer such a system wherever circumstances make it possible. In the case of the college waterworks it was especially necessary to place as little reliance as possible on pumping machinery for fire protection, because during vacation, when little water is used, the pumps would be very liable not to be ready when needed. At the best, there is always danger of delay in starting up fire pumps, which may cause the loss of the precious first few minutes at a fire. The newspapers reported that this was the case at the burning of the State University library building in 1896, and similar notices are often seen in accounts of fires.

In the case of the college waterworks the nearest approach to a gravity system possible was by the use of a large elevated tank. The college buildings are of such size and height that this tank had to be larger and higher than is usually required for village systems. As constructed, its capacity when two-thirds full is sufficient to supply four good fire streams for two hours, and the height is sufficient to throw these to the top of any building on the campus. While not an excessive, this is an ample, provision for fire protection

On an accompanying plate views of three water towers are shown. These are the largest in Iowa. The views are made to the same scale and indicate the relative sizes correctly. The college tower is the only one in the west, much larger than those at Jefferson and Fort Dodge.

The college tank is of steel, 24 feet in diameter by 40 feet high, besides the hemispherical bottom. Its capacity is 162,000 gallons, or 5,200 barrels. The balcony floor is 110 feet above the capstones, and the total height of the structure is 168 feet. The use of a steel instead of a wooden tank is a point of superiority over the ordinary tower. In designing the structure great care was taken to have all details in accord with the best engineering practice and to give ample strength to all parts. As will be explained later, great care has been taken to insure the best material and the best work in construction throughout. In all these particulars the faults common in the design and construction of water towers have been carefully avoided. Yet the cost has been no greater in proportion to the capacity and height than cities in this vicinity usually pay for their towers.

In preparing the design considerable attention was given to the appearance of the tower, which is perhaps the most conspicuous structure on the campus. In this connection it may be mentioned that a cut of the tower will appear in the next edition of the standard engineering text-book on structural designing in this country, the author of which says: "It is much the handsomest thing of the kind I have ever seen; * * * it is a great pleasure to look at it." The college water tower is the first one in this country of any considerable size in which the outline of the tower proper is curved.

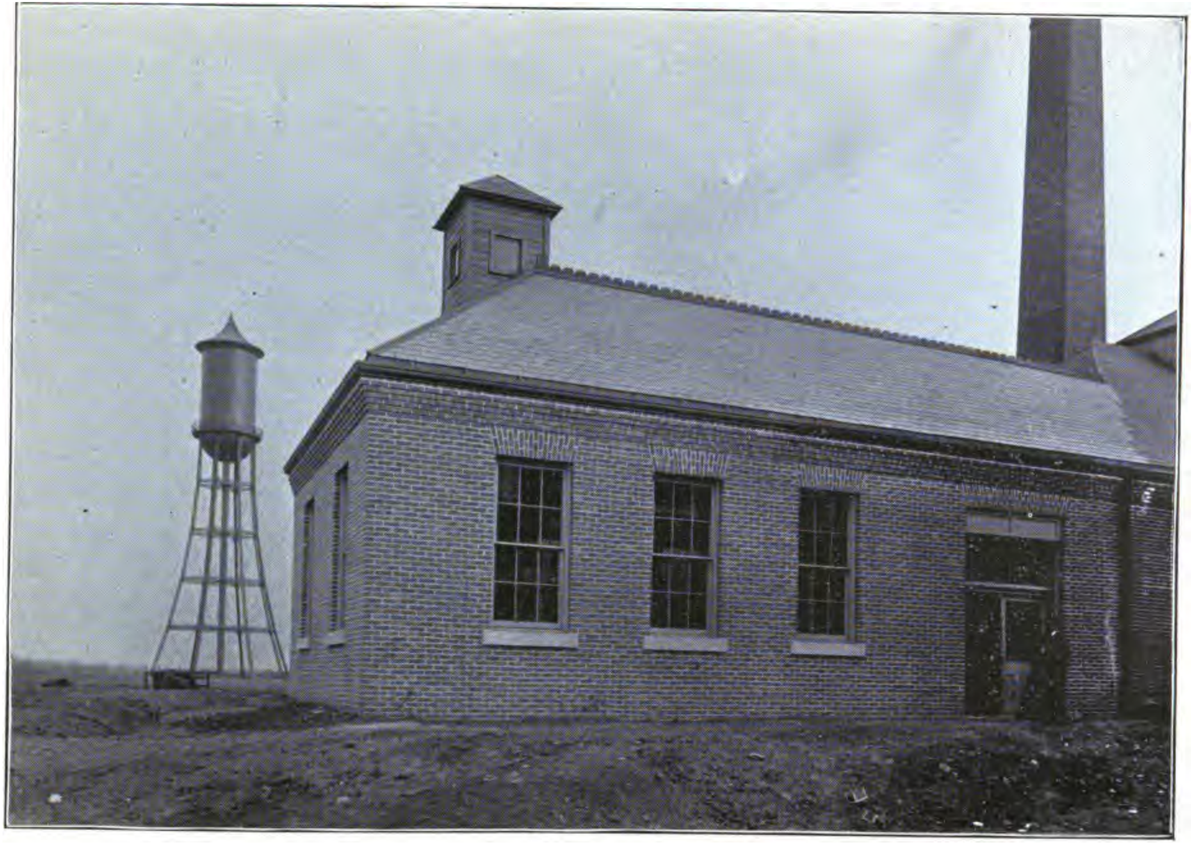
PUMPING STATION.

Exterior and interior views of the new pumping station are given on plates accompanying this report. The building is 20x42 feet inside, and besides containing the pumping machinery furnishes room for the college hose carts and for some laboratory equipment.

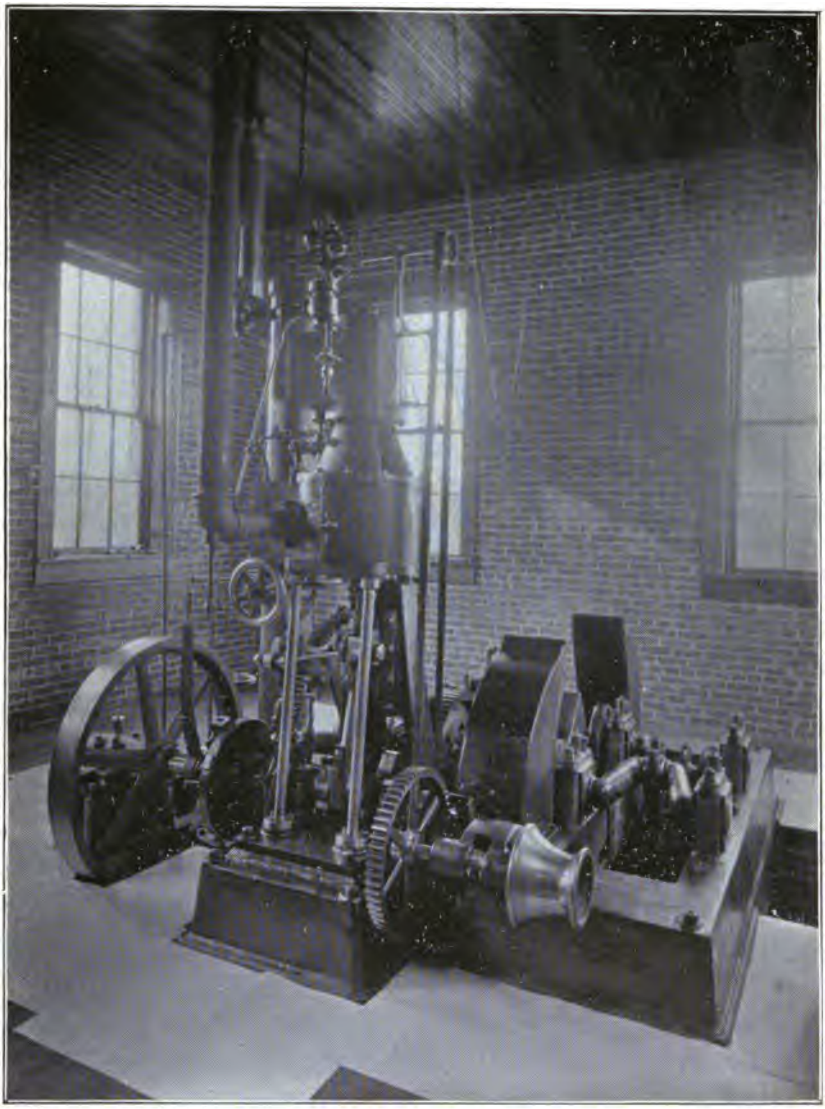
The building communicates directly with the boiler room of the college power and lighting station, the boilers of which are utilized to supply steam for pumping. The building is located directly over the artesian well, 2,215 feet deep, from which the college water supply is taken.

It may be said here that the mere fact of having the pumping station located where the power station attendant can operate the pump means an immediate saving to the college of one man's wages, or $600 annually. This, at ordinary rates on city bonds, is the interest on $12,000, which is more than the entire cost of the deep well.

In accordance with your instructions I made a very careful study of the subject of deep well pumping machinery before the contract for the new pump was let. In the course of this study I visited numerous plants actually in use, corresponded with most of the manufacturers of deep well pumps in this country, and collected much unpublished information to supplement the scanty published records of the efficiencies of different types of deep well pumps. Most of the new information was obtained through the courtesy of the managers of Iowa waterworks, with whom I corresponded. As the result of my study



DEEP WELL PUMPING STATION.



DEEP WELL PUMP.

I became convinced that deep well pumps of the types most commonly used at the present time are very inefficient. They are sold on the representations of agents, and I found it impossible to get the manufacturers to give any definite guarantees of their economy of operation. The low efficiencies of such pumps are probably the worst of the faults in Iowa waterworks systems which drain the pockets of unsuspecting taxpayers.

I found, however, that there is a decided movement at the present time to use power pumps, which are more efficient than the direct acting pumps commonly used. The trouble with this as yet is that deep well power pumps are not usually made strong and rigid enough to stand, when used for high lifts, the shocks and stresses, which are much greater than in the more elastic direct acting steam pumps.

What hydraulic engineers would like to use would be a deep well power pump which would be very strong and rigid; which would, by keeping the water in continuous motion, avoid the shocks and stresses from water hammer, and which would at the same time be highly efficient. In a word, they would like a pump which, for deep wells, could take the place of the common triplex pump for surface work.

A view of the pump purchased by the college, which is of an entirely new type, is shown on an accompanying plate. It will be seen that the entire pump is mounted on a bed plate consisting of a single heavy casting, thus insuring strength and rigidity. The pump is of the type known as double acting, having two plungers, one above the other, each of which delivers on the up stroke while the other is going down. The down stroke is made much more quickly than the up, giving time for each plunger to start up before the up stroke of the other stops. This keeps the water column in constant motion, and avoids most of the shock from water hammer due to variations in the rate of delivery. It will be seen from the cut that the pump is driven by a compound vertical engine, bolted to the bed plate of the pump. We have also arranged to secure additional economy of operation by running this engine condensing, making use of a condenser already owned by the college. The manufacturers guaranteed a duty for the pump and engine of 40,000,000 foot pounds of work per 1,000 pounds of steam. This means a saving to the college in the cost of coal of about $400 per year over the common type of deep well pump. This is the interest on $8,000, which is nearly twice the entire cost of the entire pumping station. The actual test gave a duty of 45,500,000 foot pounds per 1,000 pounds of steam, which is considerably higher than guaranteed. The information which I collected showed that the ordinary deep well pumps have efficiencies only one-ninth to one-fifth of this.

What I have said above must not be understood as an indorsement of any particular make of pump in preference to others for general use. Different pumps are suited to different circumstances, and in each particular place all the particular considerations should be considered in making a selection. In our case the water had to be pumped from a depth of 300 feet below to a height of 150 feet above the floor of the pumping station, and no fire pumps were required. I have given above the considerations which led to the selection of the pump best suited to these conditions.

SUPERVISION.

Throughout the construction of the system great care has been taken to secure good material and workmanship. Every valve, hydrant and piece of pipe was carefully inspected before allowed to be used. All the joints of the pipe lines were tested under pressure for tightness before the trenches were refilled. In refilling the trenches so much care was taken that there has been no appreciable settling since. The cement for the tower foundations was tested and one entire carload rejected because not quite up to the specifications. The mixing and the placing of every batch of concrete in the foundations was watched. Tests have also been made of cubes of concrete taken without warning from the piers during construction, and these tests show a quality of concrete very much better than the average.

By employing the services of an inspection bureau the steel for the water tower has been under supervision from the time that it was in the ore. The college has on file records giving the chemical analysis of each melt and the exact results of tests of the strength, ductility and toughness of specimens cut from its finished product. These records show also the number, kind and weight of the pieces of steel rolled from each melt, which were all carefully inspected before allowed to be shipped from the steel mills. At the shops, also, every detail of the work was carefully inspected. The paint for the tower was analyzed by Prof. A. A. Bennett of this college, free of charge.

Every detail of the construction of the system, including the erection of the tower, has been carefully supervised by myself and Mr. Macy and Mr. Ashford.

No waterworks system ever constructed in Iowa has had more careful supervision than the college system, and very likely none other has equaled it in this respect. It is unfortunately a quite general custom for our cities not to employ disinterested engineers to design their waterworks systems and supervise construction, but to trust themselves wholly to the contractors, who have every motive to escape doing good work, and who, though they style themselves "practical" engineers, are often incapable of doing more than imitate for each new place what they have seen done elsewhere, without regard to vital differences in the requirements. The plans and specifications prepared under these circumstances are often not worthy of the name, and if they were, no committee ignorant of waterworks engineering, no matter how well meaning, could prevent the tricks of the trade by which unscrupulous contractors enlarge their profits at the expense of good work. It is a matter for congratulation that there are so many contracting engineers who, under the unfavorable conditions of such competition, still do honest and able work. Since 1893 no less than four instances have come to my personal knowledge of incipient failure at the first filling of water towers designed by parties who at one time or other bid for the college tower. I have all the greater admiration for those other engineers who I know do good work with only their superior skill in designing to enable them to compete with the cheapness due to inferior work. Many well designed and constructed waterworks testify to the skill and integrity of such men. When they can be sure that all work on which they bid will be as carefully supervised and the specifications as rigidly enforced, as has been the case with the college waterworks, their task will be much easier than now.

FINANCIAL STATEMENT.

For a more detailed statement of the cost of the college system than is given below see the report of the college secretary. All the original bills are on file with the college treasurer and can be seen at any time. As will be seen in the secretary's report the payments for the system have not all been made yet, hence the cost of the different items as given below can be considered as only approximately correct. The expenditures still to be made have, however, been very carefully estimated, and the results made the total costs of the different parts of the system as follows:

Distribution system	$ 6,978.99
Water tower	10,281.37
Pumping station and machinery	4,319.44
Fire department supplies	683 05
Interior plumbing.	79.76
Consulting engineer's fee	350.00
Preparation of plans	110.13
Surveying	75.14
Inspection	221.53
Miscellaneous	101.08
Deep well	10,799.51
Total	$ 34,000.00

The deep well was not sunk under my supervision. The furnishing of a temporary water supply while the deep well was being drilled cost $2,000 in addition to the above items.

My original estimate of the cost of the waterworks system was $21,500, besides the deep well and the consulting engineer's fee. The actual costs of the different items have been very close to the original estimates except in the case of the pumping station. For this we have erected a larger and better building than was at first proposed, and also have installed a more efficient pump. This increased the first cost, but effects, as I have already shown, an annual saving which would warrant the expenditure of nearly twice the entire cost of the building and machinery.

In comparing the cost of the college waterworks with those of city systems regard should be had to many points of difference in the requirements, and account should be taken of the better grade of work secured in the college system. The most expensive single item in the college waterworks is the deep well. Most cities do not have to sink so deep a well at all to get a sufficient supply. Others put down a cheap well of small diameter, omitting much of the casing. The college could have done this at much less expense, and obtained perhaps seventy-five gallons per minute in place of the 150 gallons we now get, but in a few years we would probably have to put down another well to meet our increased needs, just as so many cities do. The total cost would then be greater than now, and we would have to operate two pumps instead of one, thus permanently increasing the operating expenses. Our water tower had to be much larger and higher than the ordinary size, because our buildings are much larger and higher than the stores and residences of small cities, and because our requirements made it advisable for us to rely wholly on our water tower for fire protection. Most cities put in cheap but very inefficient deep well pumps. Many cities cheapen the first cost of their waterworks systems by putting in small mains and not using many valves, but by so doing they make the systems of little value for fire protection. Many systems are incomplete at first, and must soon be extended and improved to meet the city's needs. Often the cost of these extensions and improvements is not taken into account in reporting the cost of the system. The cost of the college system also includes items not usually included in the published costs of city systems, such, for example, as hose, hose carts and connections to buildings.

BIDS FOR WATERWORKS, IOWA AGRICULTURAL COLLEGE, JULY 22, 1896.

ITEM.	Quantities.	NAMES OF BIDDERS.															
		Harrison-Howard Iron Co., Bessemer, Alabama.		Anniston Pipe and Foundry Co, Anniston, Alabama		National Foundry and Pipe Works, Scottdale, Pa		Jas. B. Clow & Sons, Chicago, Illinois.		M J. Drummond, Chicago, Illinois		Novelty Plumbing and Engineering Co., Sioux City, Iowa.		B. P. Eagan, Nebraska City, Neb.		Crellin & Lovell, Des Moines, Iowa.	
		Bid.	Amount	Bid	Amount	Bid	Amount	Bid.	Amount	Bid.	Amount	Bid.	Amount	Bid.	Amount	Bid	Am't.
Cast iron pipe per ton of 2,000 lbs—tons...	144 33	$22.90	$ 3,305.16	$23 55	$ 3,398.97	$22.35	$ 3,225.77	a.	$ 3,379 10	c......	$ 3,263 15	d.....	$ 4,776 48	..	....	$ 22.85	....
3-in. wrought iron pipe per ft.—feet...	60	.....	....	....	....	....	....	$ .13 27	b 7.96	......	....	$ e .32	19.20	.....	....	.19	....
2-in. wrought iron pipe per ft.—feet...	580	...	....	....	....	.....	....	.06.85	b 39.75	....	....	e .20	116 00	.....	....	.09½	....
Special castings per lb.—lbs....	16,000	.02¼	360 00	.02¼	360.00	.02⅛	340.00	.02¼	360 00	$ .02¼	360.00	.02½	400 00	f .03¼	....	.02½	....
Total for furnishing pipe........	.....	.....	$ 3,665.16	.....	$ 3,758 97		$ 3,565 77	....	$ 3,788.79	...	$ 3,623.15	...	$ 5,311 63			...	....
		R D Wood & Co, 42 Scott St, Chicago, Illinois. g		Michigan Brass & Iron Works, Detroit, Mich.		Chapman Valve Mfg. Co., Indian Orchard, Mass				National Tube Works Co, Chicago, Ill.							
Hydrants, each t.	18	$24 00	$ 432 00	h.	....	j 20.62	$ 371.16	$ k 23 50	$ 423 00	$ l 24 30	$ 437 40	$ m27 00	$ 486.00	f25.00	... .	$ n19 50	....
60-in. valves, each ..	1	28.50	28.50	$21 00	....	26 54	26.54	k 24 50	24.50	24 75	24 75	m30 00	30.00	f23.50	....	o 21.00	....
8-in. valves, each ...	13	19.50	253.50	15 00	....	17 35	225.55	18.50	240.50	17.20	223 60	20 00	260 00	17.00	... .	14 75	....
1-in valves, each ..	17	14.50	246 50	10 00	... ...	11 77	200 09	11.15	189.55	11 50	195 50	16 00	272.00	9.50	... .	9 80	... .
4-in. valves, each	3	10 50	31.50	6 25	....	7.79	23.37	7.05	21.15	7.00	21 00	9.00	27.00	6.00	....	6.25	......
3-in. valves, ir'n body	2		....	4.50	....	4.83	9 66	6.60	13 20	5 80	11 60	....	.. ....	5.00	....	5.00	.. ..
2-in. valves, ir'n body	18	......	....	3.00	....	3 45	62 10	2.60	46.80	2.88	51.84	....	......	2.65	....	4 50	....
3-in. val's, brass body	....	..	....	...	....	....	....	....	....	... ...	....	....	... ...	6 25	....	3 50	....
2-in. val's, brass body	......	...	....	......	....	...	....	......	....	....	....	....	....	2.65	....	2.50	....
Valve boxes, each...	54	.....	....	2.60	....	......	....	....	....	dd 4.00 f 4.30	224.10	....	....	3.00	....	4.35	.. ..
Tot. for furnishing valves, hydrants & boxes.	.. ...	......	....	......	$ i 985.00	......	....	....	....	....	$ 1,189.79	....	....	....	....	....	....

		Fremont Turner, Des Moines, Iowa.		Jackson & Moss, Des Moines, Iowa.													
Laying 10-in. pipe per ft.—feet	120	$ p .20		$ .30	$ 36.00									$ f .96		$ .27	
Laying 8-in. pipe per ft.—feet	5,900	.20		.26	1,534.00									.70		.24	
Laying 6-in. pipe per ft.—feet	900	.20		.23	207.00									.55		.21	
Laying 4-in. pipe per ft.—feet	180	.20		.21½	38.70									.41		.19	
Laying 3-in pipe per ft.—feet	60	.20		.19	11 40									.29		.18	
Laying 2-in. pipe per ft.—feet	580	.20		.16½	95 70									.19		.18	
Setting each hydrant	18	1.00		3 00	54.00											4.00	
Setting each valve and valve box	54	1.00		1.00	54 00											3 00	
Extra excavati'n, per cubic yard		.25		.40										.20		.30	
Extra labor, per hour				.15										.20		.15	
Extra teams. per h'r.				.27½										.30		.27	
Furn. & laying 4-in. drain tile per ft.—ft	750			.10	75 00									.12		.08	
Tot. for constructing dist'n system					$ 2,105.80												
Tot for material and labor for distribution system															$ 6,559		$ 6,624
						Columbiana Boiler Works, Columbiana, Ohio. s		Riter & Conley, Pittsburg, Pa.		King Bridge Co, Cleveland, Ohio		Chicago Bridge and Iron Co., Chicago, Ill.		J. B Marsh, Des Moines, Iowa.			
Tower and tank							$ 14,503				$ 8,888						$ 9,413
Foundations																	1,380
Total for water tower.			$ 11,650		$ 12,500				$ q 15,300				$ r 12,444		$ 15,500		$ 10.793

a 4-in, $24.30; 6-in., 8-in , 10-in , $23.40 *b* F. O B. Chicago. *c* 10-in., $22 30; 8-in., $22 55; 6-in., $23 05; 4-in., $23 55. *d* 10-in., $31; 8-in , $33; 6-in , $34; 4-in , $36; *e* Galvanized. *f* Furnishing and laying. *g* Matthews hydrants, Eddy valves. *h* $22 for Gate hydrants; $22.50 for compression hydrants. *i* $995 with compression hydrants. *j* $3.05 additional for frost cases *k* Eddy hydrants and valves *l* Ludlow hydrants. $27, with frost cases. *m* Waterous hydrants, Ludlow valves. *n* For Bourbon hydrants; Waterous, $24 75 *o* Bourbon valves. *p* For ditch five feet deep; several conditions to bid. *q* Exclusive of drain tile; copper roof, $300 extra; double strap butt joints, $750 extra; drain tile, 40 cents per foot. *r* Bid also $10,444 for four-post tower, $11,994 for eight-post tower, of their own design; $14,474 for eight-post tower with tank 27 x 45 feet. *s* With copper roof; extra price for double strap butt joints, $400; material f. o. b. Ames, for $11,653, or $11,853 with butt joints. *t* The Waterous Engine Works Co, of St. Paul, Minn., bid $26 each for Waterous hydrants.

If all these things are properly taken into account it will be found that no more economical waterworks system was ever constructed in this state than the college system. Every dollar put into it represents value received. There was strong competition for all the contracts and they were let at figures which allowed only narrow margins for profits to the successful bidders.

The bids for the distribution system and water tower were as given in the secretary's report. Eleven separate bids were received for the hose and hose carts, and eighteen for a part or all of the pumping station and machinery. In both of these cases the bids were based on such widely different grades of material or machinery that it is impossible to present in reasonable space a fair comparison of them. The original bids are on file with the college secretary and in my office. Respectfully submitted,

A. MARSTON.

PROCEEDINGS OF BOARD OF TRUSTEES.

ABSTRACT OF THE PROCEEDINGS OF THE BOARD OF TRUSTEES, 1896-97.

MEMBERS OF THE BOARD.

	TERM EXPIRES.
First District.—Hon. Hamilton Smith, New London	1898
Second District.—Hon. C. M. Dunbar, Maquoketa	1898
Third District.—Hon. J. S. Jones, Manchester	1902
Fourth District.—Hon. A. Schermerhorn, Charles City	1898
Fifth District.—Hon. A. V. Stout, Parkersburg	1900
Sixth District.—Hon. W. O. McElroy, Newton	1902
Seventh District.—Hon. C. F. Saylor, Des Moines	1900
Eighth District.—Hon. A. B. Shaw, Corning	1898
Ninth District.—Hon. L. B. Robinson, Oakland	1902
Tenth District.—Hon. J. B. Hungerford, Carroll	1900
Eleventh District.—Hon. W. J. Dixon, Sac City	1900

OFFICERS OF THE BOARD.

Hon. W. O. McElroy, Newton	*Chairman*
E. W. Stanton, Ames	*Secretary*
Herman Knapp, Ames	*Treasurer*
J. F. Cavell, Ames	*Steward*

STANDING COMMITTEES OF THE BOARD.

Finance Committee.—Trustees Dunbar, Smith, Schermerhorn, McElroy and Robinson.

Building Committee.—Trustees Shaw, Saylor, Jones, Hungerford and Stout.

Committee on Agriculture, Horticulture, Experiment Station and Veterinary Science.—Trustees Schermerhorn, Stout, Smith, Dixon and Saylor.

Committee on Steward's Department, Domestic Economy, College Hospital and Sanitary Arrangements.—Trustees Robinson, Shaw, Hungerford and Saylor.

Committee on Engineering Departments and Physics.—Trustees Jones Dunbar and McElroy.

Committee on Faculty and Courses of Study.—Trustees Hungerford, McEl,roy, Shaw, Stout and Robinson.

Committee on College Lands and Investments.—Trustees Smith, Jones and Dunbar.

Committee on Rules.—Trustees Dixon, Saylor and Schermerhorn.

Committee on Scientific Departments.—Trustees Stout, Hungerford and Schermerhorn.

Committee on Literary Departments and Library.—Trustees Robinson, Shaw and Saylor.

Committee on Public Grounds and Assignment of Rooms.—Trustees Smith, Dunbar and Jones.

Committee on Bonds.—Trustees Dixon and McElroy.

MEMBERSHIP OF THE BOARD.

The terms of office of Hon. J. S. Jones of the Third district, Hon. W. O. McElroy of the Sixth district and Hon. J. H. Wood, of the Ninth district, expired May 1, 1896. The first two were re elected, while Hon. L. B. Robinson was chosen to succeed Mr. Wood. Hon. A. F. Meservey of the Eleventh district, resigned in June, 1896, and the general assembly, at its extra session in the winter following, elected W. J. Dixon to fill the vacancy. No other changes have occurred in the membership of the board during the biennial period.

Members to represent the First, Second, Fourth, and Eighth districts for the term of six years, beginning May 1, 1898, are to be elected by the Twenty-seventh General Assembly. The trustees ask that the legislature make the governor and superintendent of public instruction *ex officio* members of the board.

STATE APPROPRIATIONS.

It is the duty of the board of trustees to direct the expenditures of all the appropriations which the general assembly shall from time to time make to the college. These appropriations are of two classes:

1. Particular appropriations for specific purposes.
2. Annual appropriations.

All appropriations of the first class, except those of the Twenty-sixth General Assembly, have been accounted for in previous biennial reports. The appropriations of this assembly were as follows:

Emergency fund for deep well	$ 15,000
Equipment of waterworks, including tower and steel or iron tank	21,000
Greenhouse	6,000
Forge shops and foundry with fixtures	5,000
Farm barns	4,000
Sewage disposal system	3,500
Total	$ 54,000

The college was compelled, in the fall of 1895, to close its school year two weeks earlier than usual because of the failure of the water supply. It was evident that provision must be immediately made for a permanent and ample supply of water, and that while such permanent system was being put in a temporary supply, sufficient to meet the needs of the college, must be provided. In this emergency the state executive council, acting under the provisions of section 1, chapter 67, laws of the Seventeenth General Assembly, authorized the trustees to proceed at once with the necessary plans to obtain such supply. Acting under this authority the trustees entered into a contract with Gray & Bro., of Chicago, to sink a deep well and to put down, in the gravel-bed east of the college, a well or series of wells which should furnish, during the drilling of the deep well, a continuous supply of water of not less than 2,000 gallons per hour, equal in quality to that hitherto obtained by the institution. The order of the executive council, and an abstract of the contract with Gray & Bro., are given on pages 128 and 129 of the last biennial report. Upon the meeting of the legislature, the whole matter was presented to that body and an appropriation asked to meet the expense of sinking the deep well and providing for a temporary water supply; and in addition to construct and equip a waterworks plant of a capacity equal to the present and probable future needs of the college. For the purposes mentioned the total sum of $36,000 was appropriated, divided as already stated.

DEEP WELL.

The deep well was completed in February, 1897. The amount paid Gray & Bro. under their contract was $12,730.89, as follows:

For 120 feet with 12-inch casing at $6.65	$ 798.00
For 299 feet with 10-inch casing at $5.94	1,781.01
For 648 feet with 8-inch casing at $5.23	3,389 04
For 362 feet with 6⅝-inch casing at $4.52	1,636.24
For 505 feet with 5⅝-inch casing at $4 04	2,040.20
For 280 feet uncased 5¼-inch hole at $3.88	1,086.40
2215 feet	$ 10,730 89
Temporary water supply	2,000.00
Total	$ 12,730.89

There has been charged to this deep well appropriation the expenses of inspection, testing, express, and other minor charges, together with a portion of the cost of the house over the well, which is to serve as the pumping station. The following is the condition of the account as it stood at the close of the biennial period:

EMERGENCY FUND FOR DEEP WELL.

Amount of appropriation		$ 15,000
EXPENDED.		
Paid Gray & Bro. for sinking deep well	$ 10,730.89	
Paid Gray & Bro. for sinking temporary wells and guaranteeing water supply, delivered in college water mains, until completion of deep well	2,000.00	
Paid Jackson & Moss part of contract for erection of house over deep well	1,228.73	
Paid Mr. Boutelle for services as assistant superintendent	25.00	

Cost of apparatus and wages of men testing well	35.91	
Express, messages, and cover for well	7.71	
Expenses of engineer purchasing pump	38.13	
Amount expended	$ 14,066.37	
Balance in state treasury reserved by the board for payment on contract for deep well pump	933.63	
Total		$ 15,000

A special committee of the board of trustees, consisting of Messrs. Dunbar, McElroy, and Robinson, has had general oversight of the sinking of the well. Under the direction of this committee General Lincoln has served as superintendent of construction. Professor Beyer has taken record of the geological strata; Professor Weems has made analyses of the water, and Professor Marston has tested the capacity of the well. From the reports of these officers to the board the following interesting facts are gathered:

Source of Water Supply.— Professor Beyer states that the well is supplied from the geological formations known as the Saint Peter, the Oneonta, and the Saint Croix. These formations are located as follows:

FORMATION.	EXTENT BELOW SURFACE.	THICKNESS.
Saint Peter	1,420—1,490 feet	70 feet
Oneonta	1,490—2,100 feet	510 feet
Saint Croix (in part)	2,100—2,215 feet (penetrated)	115 feet

The Saint Peter formation is composed largely of white beach sand. The Oneonta is essentially a massive dolomite bisected by a well-marked sand-bed. This sandstone band, which is about twenty feet thick at Ames, is known by Minnesota geologists as the New Richmond, and is one of the chief water-bearing horizons of that state. The Saint Croix, in central Iowa, can be separated into three fairly well marked divisions—an upper sandstone, a medium series of dolomites and shales, and a lower member which comprises sandstones, marls and shales. The upper two are known as the Jordan sandstones and the St. Lawrence shales, respectively. The college well penetrates the Jordan, which has a thickness of 100 feet, and ends in the St. Lawrence. The Jordan sandstone, with the New Richmond and St. Peter, are the great reservoirs from which the well may draw. Their ability to contribute to the general water supply, according to pumping tests from these horizons, is in the proportion of 15, 4, and 1, respectively.

Permanency of Supply.—Prof. W. H. Norton, of the Iowa Geological survey, in speaking of the water-bearing sandstones which furnish this and the other artesian wells of the state with water, after estimating the area of supply, says: "As this equals 14,500 square miles, and we have estimated the porosity of the sandstone at 5 per cent, the reservoir sandstones thus contain an amount of water equivalent to a lake the area of Lake Ontario and fifty feet deep. To fill this reservoir, if one-tenth of the rainfall of the region were devoted to this purpose, would require nearly 100 years. To exhaust it by the discharge of the artesian wells of Iowa, estimating their output at 36,000,000 gallons daily, would require over 5,000 years. Limiting our calculation to the outcrop of the reservoir sandstones, we have omitted the scores of thousands of square miles in the Upper Mississippi valley, in which these strata are buried more or less deeply beneath the surface, their porous strata being everywhere waterlogged. The entire storage of artesian water in this field becomes so enormous that it passes beyond ready computation. It represents the accumulation of centuries." "It is thus clear," adds Professor Beyer, "that, if the lower paleozoic sandstone reservoirs should receive no further increment of water from the annual rainfall, the supply, apparently, would remain undiminished for generations to come, even though the demand be increased an hundred fold."

Quality of Water.—The water of the deep well was analyzed by Prof. J. B. Weems, professor of agricultural chemistry in the college. The analysis was conducted with an idea of determining its value from a sanitary point of view, and also its suitability for boiler purposes. The following is the sanitary analysis put in tabulated form by the professor for the purpose of easy comparison with the analyses of water from other representative deep wells of the state:

SANITARY ANALYSIS.

PARTS PER MILLION.	College.	Boone.	Cedar Rapids.	Centerville.	Davenport.	Sioux City.
Free ammonia	1.2	1.4	.862	.978	1.1	1.25
Albuminoid ammonia	Trace	.015	.016	.020	.005	.015
Solids	1258	2047.14	592.9	4132.14	1192.85	1617.14
Nitrogen as nitrites	Trace	None	.8	4.8	None	Trace
Nitrogen as nitrates	Trace	None	.16	None	None	Trace
Oxygen absorbed in 15 minutes	....	.74	1	1.68	.9628	.06
Oxygen absorbed in four hours	....	.74	.8	2.48	.9854	1.85

The professor, after discussing in his report the significance of solids in water, showing that their presence is not necessarily harmful in a sanitary view, remarks: "The amount of free ammonia found in deep wells is much larger than is found in shallow wells. The determination is only of value when the amount of albuminoid ammonia is large. The amount of albuminoid ammonia present in deep well water is very small, as is shown by the foregoing table."

In classifying water for boiler purposes the professor states that the following limits have been proposed for the amounts of the scale-forming substances:

Very good	Less than 8 grains per gallon
Good	8 to 15 grains per gallon
Fair	15 to 20 grains, per gallon
Poor	20 to 30 grains per gallon
Bad	30 to 40 grains per gallon
Very bad	40 grains and over per gallon

His analysis shows the following:

Total amount of scale-forming substances—grains per gallon: Ames, 8.62; Boone, 45.82; Cedar Rapids, 18.03; Centerville, 76.81; Davenport, 4.90; Sioux City. 60.12.

The professor, in summing up the results of his investigation, says: "The samples of water from Davenport and Ames contain the least amounts of scale-forming substances. This fact, taken in connection with the purity of the Ames water as regards organic matter, impresses the fact, when the depth of the well is taken into consideration, that the college has a water supply which ranks among the best in the state as to quality.

Capacity of Well.—Upon the completion of the well its capacity was thoroughly tested. The tests were made under the supervision of Professor Marston. The results, as tabulated by him, are given below:

TIME.	Flow over weir in gallons per hour.	TIME.	Flow over weir in gallons per hour.
February 5, 1897—		*February 5, 1897—*	
2:20 A. M.	5500	8:03 A. M.	5800
2:46 A. M.	6700	8:10 A M.	4900
3:00 A. M.	6200	8:30 A. M.	5400
3:15 A. M.	6200	8:50 A. M.	5100
3:30 A. M.	6900	9:10 A. M.	4600
3:45 A. M.	6900	9:30 A. M.	5700
4:00 A. M.	6400	9:50 A. M.	6000
4:22 A. M.	6300	10:10 A. M.	6200
4:44 A. M.	6400	10:30 A. M.	5000
5:09 A. M.	6000	11:40 A. M.	5000
5:36 A. M.	6400	12:00 M.	5800
6:10 A. M.	5800	12:20 P M.	5500
6:24 A. M.	7400	12:40 P. M.	5200
6:53 A. M.	6200	1:00 P. M.	4400
7:30 A. M.	5800	1:20 P. M.	4200
7:38 A. M.	7000	1:40 P. M.	4400
7:50 A. M.	5400	2:01 P. M	7000

The professor, in explanation of the table, writes as follows: "During the tests several short stops were made to repair the pump, which was not strong enough for the work, and generally broke or stuck when an attempt was made to speed it up to the full capacity of the well, hence the amount pumped cannot be considered to be in general up to the full capacity of the well. As, however, air was drawn through the cylinder several times during the tests, the higher readings probably represent the capacity fairly well. During the tests the pump cylinder was at a depth of 270 feet below the surface of the ground. Before the tests began the level of the water was determined to be twenty-nine feet below the surface of the ground. After the completion of the tests the water stood twenty-five feet below the surface."

Later tests made by Professor Marston with the new pump would seem to show that the new well can be relied upon to furnish 8,000 gallons per hour. A permanent and ample supply of good water is thus insured to the college.

WATERWORKS

The appropriation for the college waterworks was based on plans and estimates prepared by Professor Marston, the head of the civil engineering department. These plans were afterwards approved by the consulting engineer employed by the board, and the waterworks system was constructed in accordance therewith. The plans for the completed plant contemplated a tower with steel or iron tank, a distribution system, a pumping station, the necessary pumping machinery, and such fire department supplies as would enable the works to furnish, as far as possible, fire protection to the different college buildings.

Bids for the erection of the tower and tank, and the construction of the distribution system, were opened by the board at its meeting in July, 1896. In the matter of the tower and tank, six bids were received which included the tower foundation, three which did not include it, while one firm, Crellin & Lovell of Des Moines, submitted figures for putting in the foundation, conditioned upon receiving contract for erection of tower or construction of distribution system. The bids on the tower and tank without the foundation ran from $8,888 to $14,503; the bids on the tower and tank, including the foundation, ran from $10,793 to $15,500; the Crellin & Lovell bid on the foundation was $1,380. It was found by accepting this bid and the bid of $8,888 by the King Bridge Co., of Cleveland, Ohio, to erect the tower and tank, the complete structure could be secured for $10,268, which was less than any of the bids upon the structure as a whole. Contracts were consequently made with these parties upon the basis of their bids. It was afterwards found that each party had included in its bid the anchor-bolts for anchoring the tower to its foundation. The value of these, with certain minor deductions amounting altogether to $229.58, reduced the amount finally paid Crellin & Lovell on the tower foundation to $1,150.42. Extras amounting to $77.92 were allowed the King Bridge Co. The college paid, on account of certain items not included in either contract, such as setting anchor-bolts, putting in inlet pipe foundations, painting tank a third coat and grading around the tower, the sum of $165.03, thus making the total cost of the tank, tower and foundation, $10,281.37.

Numerous bids were received on furnishing the material and on constructing the distribution system. The bids of P. J. Egan, of Nebraska City, Neb , and Crellin & Lovell, of Des Moines, covered the material and labor for the completion of the system and were respectively, $6,559 and $6,624. The bid of Crellin & Lovell was accepted, such action being necessary in order to secure contract with them for the tower foundation, the gain on which to the college exceeded the excess of their bid over that of Mr. Egan. For extra labor and material furnished by them Crellin & Lovell were afterward allowed the sum of $250.32. Connecting the deep well with the mains of the general system was not included in their contract. The expense to the college of making these connections was $104.67. These amounts, added to the contract price, bring the total cost of the distribution system up to $6,978.99.

The bids on the pumping station and machinery were opened at the meeting of the board in May, 1897. Four bidders submitted figures on the erection of the pumping station, ranging from $1,330 to $1,432.95. The contract was let to the lowest bidder, Jackson & Moss, of Des Moines. An agreement was also made with these parties to build the foundations for the pumping machinery and install the same for the sum of $290, making the total of their contract $1,620. During the progress of the work an allowance of $10.64 was made to them because of delay in the arrival of the pumping machinery and $77.99 for additional labor and material caused by modification of the original plans. Final settlement with them was not effected until after the close of the biennial period. They had been paid at that time the sum of $1,275 of which $1,223.73 was charged to the deep well fund, as already explained, and $46.27 to the waterworks account. The balance of $345 due on their contract and the extras allowed, $88.63, are to be paid from the unexpended balance of the waterworks appropriation.

There were eighteen bids on the pumping machinery. Upon the recommendation of Professor Marston, who had made an exhaustive study of deep well pumps, the proposition of Henion & Hubbell of Chicago, to furnish a continuous flow pump "Cambridge" type, with a Morris Machine works compound engine on the same bed plate, and the necessary drop pipe and rods for $2,275, was accepted. The pump and engine are guaranteed a capacity of easily lifting 8,000 gallons of water per hour from a depth of at least 300 feet below the surface and delivering it into the elevated tank at a height of 155 feet above the surface. A guarantee of efficiency and durability is also given. The machinery has been installed and a duty test made which has proven eminently satisfactory. Payment of the last half of the contract price is to be made at the expiration of sixty days, conditioned upon the satisfactory working of the pump and engine. Because of delay in delivering machinery a reduction of $10.64 was made in their contract.

The balance of $2,264.36, which is yet unpaid, was ordered charged as follows:

To the deep well fund	$ 933 63
To the waterworks appropriation	1,330.73

Fixtures for the pumping station, including steam piping, steam heating, fittings for setting up condenser, and gauges, have been purchased at a cost of $208.32. It is estimated that $100 additional will be needed to complete the equipment. The items mentioned, together with the expense bill of Professor Marston in investigating pumps and purchasing machinery, $38.13, make the total cost of pumping station and fixtures and deep well machinery, $4,319.44.

Under the direction of the board, Professor Marston secured bids on hose carts, hose, and such hose connections as were necessary to utilize the waterworks plant for fire protection purposes.. Eleven bids were submitted: The contract was finally let to the Gutta Percha and Rubber Manufacturing Co. of Chicago to furnish two carts, 500 feet of Maltese Cross brand, best two and one-half inch rubber hose, four play pipes, and fourteen nozzles for $671. Tips for hose carts costing $9 were afterwards purchased. Freight, drayage, and minor items amounted to $3.05, making total cost of fire department supplies $683 06.

All other expenditures connected with the construction of the waterworks are clearly set forth in the exhibit which follows. It is the purpose of this exhibit to show the condition of the fund at the close of the biennial period, and, as far as possible, the way in which the balance of the appropriation is to be expended.

WATERWORKS APPROPRIATION.

Amount of appropriation		$21,000.00
EXPENDITURES.		
Paid King Bridge Co. on contract of $8,888.00 for erection of tower and tank	$ 7.552.08	
Paid King Bridge Co, extras	77.92	
Paid Orellin & Lovell, contract price for tower foundation, $1,380, less deductions as explained amounting to $229.58.	1,150.42	
Paid for putting in inlet pipe foundation, painting tank third coat and other items as explained	165.03	
Total paid on tower		$ 8,945.45
Paid Orellin & Lovell, contract price on distribution system	$ 6,624.00	
Paid Orellin & Lovell, extras as explained	250 82	
Paid for connecting deep well with mains of general system	104.67	
Total cost of distribution system		6,978.99
Paid Jackson & Moss on contract for erection of pumping station.	$ 46 27	
Paid for pump house fixtures as explained	208.32	
		254.59
Paid for fire department supplies		683.05
Paid consulting engineer's fee		350.00
Paid for preparation of plans and specifications		110.13
Paid for surveying		75.14
Paid for inspection and testing		221.53
Paid for advertising, stationery, postage and messages		59 77
Total expended		$ 17,678.65
The unexpended balance will be used to meet the following:		
Balance due on King Bridge Co.'s contract		1,335.92
Unpaid on pumping station and machinery:		
Balance of Henion & Hubbell's contract for pump	$ 1,330.73	
Balance due on Jackson & Moss, contract for pumping station.	345 00	
Due Jackson & Moss on extras	88.63	
Bills for pumping station fixtures (partly estimated)	100.00	1,864.36
Minor items, including engineer's expenses for messages, stationery, postage and express		41.31
Inside plumbing to connect college buildings with distribution system—balance		79.76
Total		$ 21,000.00

Professor Marston designed the waterworks system, and it has been constructed under his direct supervision. It has been commended by the highest engineering authorities, and in its practical workings has proven an efficient and economical system, a credit to the college and to the professional skill and conscientious public service of its designer. The report of Professor Marston to the board is printed in full under the head of "financial reports." It gives a detailed description of the system, and contains many suggestions regarding the construction of waterworks plants which are of public interest.

The professor, as superintendent, has been assisted by the special committee of the board on waterworks, Trustees McElroy, Jones and Saylor. All expenditures on account of the appropriation have been signed correct by Professor Marston, and afterward approved by Trustee McElroy, before presentation to the board of audit.

GREENHOUSE.

The appropriation asked of the legislature was $12,000. The amount granted was $6,000. This necessitated a change in the plans, the strictest economy in construction, and the payment, out of the annual improvement fund, of a portion of the expense of the heating plant. Upon the basis of the new plans, bids were solicited and the same opened at the meeting of the board in July, 1896. The bids were as follows:

Lord & Burnham Co.	$4,600.00
Hitchings & Co.	4,939.20

Lord & Burnham Co. also submitted a proposition to erect the building upon plans which differed but slightly from those of the board, for the sum of $4,500. This proposition was accepted and contract executed in accordance therewith. The building was constructed under the supervision of a special committee appointed by the board, consisting of Trustees Schermerhorn and Shaw and Professor Budd. It was completed to the satisfaction of this committee and payment made of the contract price. There were no extras and no deductions.

The committee secured bids on heating plant, ranging from $1,249.20 to $1,989. The bid of Lord & Burnham Co., which was the lowest, was accepted. The plant was installed and has proven satisfactory. The contract price was ordered charged as follows:

To the greenhouse appropriation	$	843.78
To the annual appropriation for improvements and current expenses		405 42
Total	$	1,249.20

The foundation of the greenhouse was built under contract by L. Hullabarger at a cost, including excavating, of $585.02. An old potting house belonging to the horticultural department was moved so as to join the greenhouse, and its basement was fitted up to contain the heating plant furnaces. A part of the expenses was charged to the greenhouse appropriation The following condensed statement shows how the entire fund was expended:

GREENHOUSE APPROPRIATION.

Amount of appropriation	$	6,000.00
EXPENDITURES.		
Lord & Burnham Co.'s contract for erection of building		4,500.00
Part of Lord & Burnham Co.'s contract for putting in heating plant		843.78
Cost of foundation		585.02
Part of expense of moving and remodeling potting house addition		62.55
Drayage on material		7.85
Messages		.80
Total	$	6,000.00

FORGE SHOP.

The general assembly appropriated for forge shops and foundry with fixtures the sum of $5,000. It also provided that any sum remaining, after the completion of the other special improvements for which appropriation was made, might be used, so far as necessary, for the shop and fixtures. No additional amount was thus realized, but the erection of the shop was delayed in order that this question might be determined.

Bids were received at the meeting of the board in June, 1897, based upon plans approved by the trustees. The following are the bids:

J. F. Atkinson & Bro., Marshalltown, Iowa	$3,464 00
A. H. Chaffee, Corning, Iowa	4,067 00
G. L. Tucker	4,550 00
Turner & Duntz, Ames, Iowa	4,164 32
Jackson & Moss, Des Moines, Iowa	3,479.00

The contract was let to the lowest bidder, J. F. Atkinson & Bro. of Marshalltown. Architect Hallett of Des Moines was employed as supervising architect at a compensation of 2½ per cent of the cost of the building. The following exhibit shows the amount of the appropriation expended prior to the close of the biennial period and the purposes for which the unexpended balance will be used:

FORGE SHOPS AND FOUNDRY WITH FIXTURES

Amount of appropriation		$ 5,000.00
EXPENDITURES.		
Paid Atkinson & Bro. on contract of $3,469.00 for erection of building	$ 1,041.04	
Paid part of architect's fee	35.00	
Paid for blower, blast pipe, cupola and other fixtures	755.37	
Total expended		1,831.41
The unexpended part of the appropriation is to be used to meet the following:		
Balance of Atkinson & Bro.'s building contract	$ 2,427.96	
Balance of architect's fee	51.50	

Extras allowed Atkinson & Bro. on contract	$ 54.25	
Stock house for coke and coal, benches, cases and other necessary equipment	634 88	
Total		$ 3,168.59
Total		$ 5,000 00

The expenditure of this appropriation is under the charge of the committee on engineering departments, of which Trustees Jones, Dunbar and McElroy are members. Professors Bissell and Marston have acted as local superintendents. All bills before presentation to the board of audit are certified to as correct by Professor Bissell and approved by Trustee Jones.

FARM BARNS.

The necessity of repairing the foundation of the farm barn, and thoroughly reconstructing the basement and first story, was presented to the legislature at its last session and an appropriation of $5,000 asked for this purpose. The amount granted was $4,000. At the meeting of the board of trustees in May, 1896, the following resolution was adopted:

> WHEREAS, The repairing of the old barn cannot be practically done under contract, owing to the uncertain amount of material that may be called for; therefore,
>
> *Resolved*, That the building committee, in conjunction with the farm committee, proceed at once to accomplish its repair by day's work, under the supervision of a competent man, agreed upon by the committees in charge, the college to purchase all needed material and the work to continue until the appropriation is expended.

In accordance with this resolution a practical carpenter, Mr. T. Thompson, of Ames, was placed in direct charge of the work, while Professor Wilson was appointed superintendent. In his report at the November meeting the professor says: "The repairs on the farm barn have been carried as far as the appropriation will permit. We are now enabled to present to the public our herds in comfortable condition, and care for them with a great saving of labor. There is more work to be done in finishing the south end of the barn. We also require a silo and a root cellar of greater capacity." He then speaks of the necessity of remodeling the upper part of the barn. A portion of these additional improvements have been made by the board and charged to the annual state appropriation; the others are presented to the legislature for consideration. The entire expenditures on account of the fund amount to $3,996.68, leaving an unexpended balance of $3.32 in the hands of the state treasurer.

SEWAGE DISPOSAL SYSTEM.

In presenting the needs of the college to the last general assembly President Beardshear called attention to the necessity of of adopting some method of disposing of the sewage of the different college buildings. He mentioned the plan of filter beds with tank, automatic discharging apparatus, pipeline, and necessary connections for utilizing the sewage for fertilizing the low land near the mouth of the sewer. At the first meeting of the board following the regular session of the legislature, the trustees took up the consideration of the best method of disposing of the sewage with the appropriation of $3,500 which the general assembly had made for that purpose. The matter was referred to a special committee consisting of Trustees McElroy, Saylor, and Stout. This committee reported that they considered the various plans of disposing of sewage by utilizing it for fertilizing purposes as largely experimental, with considerable doubt as to the result. The committee therefore recommended that, in addition to securing bids upon this method of disposal, proposals be asked for putting in the crematory system. Bids were submitted to the board at its July meeting. The lowest bid on the filter bed system was that of Jackson & Moss, of Des Moines, based upon plans and specifications prepared by Professor Marston. Under this bid the professor estimated that the system could be put in operation for $3,154. The most satisfactory bid on the crematory system was that of the Engle Sanitary and Cremation Co. of Des Moines, to install the necessary plants at the main building and boarding cottages for $3,300. This, with the cost of building for plant at cottages, $675, would make the cost of the system complete $3,975. This bid was modified at a subsequent meeting, by changes in the specifications, so as to bring it within the amount appropriated by the state. The board did not, however, as a whole, feel satisfied with either system. All bids, therefore, were rejected and the committee in charge directed to continue its investigations into the merits of the two systems. Such further investigation having failed to produce an agreement in favor of either system, the board at its meeting in November, 1897, decided to extend and perfect the present college system of sewers. A leading consideration in reaching this conclusion was the successful installation of a waterworks plant which insures an abundant supply of water. The final action of the board is embodied in the following orders:

1. Ordered that the boarding cottages, the college hospital, South hall, and such other buildings as Professor Marston may decide upon be connected with the college sewerage system and that the expense thereof, together with the cost of plumbing and necessary inside fixtures in such buildings, be charged to the state appropriation of $3,500 for sewage disposal.

2. Ordered that the building committee take up the work as outlined by the board, contract for and execute it, at the earliest possible date.

3. Ordered that the committee on scientific departments be directed to investigate the question of the expenditure of the balance of the state appropriation for sewage disposal, and report to the board.

The expenditures for plans, advertising, and other minor expenses to date, amount to $44.55.

ANNUAL APPROPRIATIONS.

The following laws, making annual appropriations to the college, were in force at the beginning of the biennial period:

(Chapter 67, Acts of the Eighteenth General Assembly.)

Be it enacted by the General Assembly of the State of Iowa:

SECTION 1. That there is hereby appropriated to the Iowa Agricultural college, out of any moneys in the treasury not otherwise appropriated, the sums for the purposes herein named, to-wit: * * * for needed repairs upon college buildings and for necessary expenses incurred in the management of college lands, the sum of one thousand dollars ($1,000) annually, the first payment to be made May 1, 1880, and the same sum annually thereafter.

(Chapter 78, Acts of the Nineteenth General Assembly.)

Be it enacted by the General Assembly of the State of Iowa:

SECTION 1. That there is hereby appropriated to the Iowa Agricultural college, out of any moneys in the treasury not otherwise appropriated, the sums for the purposes herein named, to-wit:

* * * * * * * * * *

Ninth.—For experimentation in agriculture and horticulture an annual appropriation of one thousand five hundred dollars ($1,500).

SEC. 4. That the first payment of the amount appropriated in the ninth item herein be made on May 1, 1882, and the same annually thereafter.

In each of the above appropriations it was provided "that the board of trustees shall take vouchers in duplicate of all moneys expended under this appropriation, one of which shall be filed in the office of the auditor of state."

(Chapter 126, Acts of the Twenty-second General Assembly.)

Be it enacted by the General Assembly of the State of Iowa:

SECTION 1. That there is hereby appropriated for the Iowa Agricultural college, out of any money in the state treasury not otherwise appropriated, the following sums for the following purposes, to-wit:

Fourth.—For repairing and improvement of college buildings, the sum of one thousand dollars annually, which sum shall be in addition to the present annual appropriation of one thousand dollars, the first payment to be made May 1, 1888, and the same sum annually thereafter.

(Chapter 145, Acts of the Twenty-fifth General Assembly.)

Be it enacted by the General Assembly of the State of Iowa:

SECTION 1. That there is hereby appropriated to the Iowa State Agricultural college, out of money in the state treasury not otherwise appropriated for repairs, general improvements and current expenses, the sum of fifteen thousand dollars annually hereafter; said sum to be paid in quarterly installments on the order of the trustees, the first installment to be payable September 1, 1894.

These several appropriations were consolidated under the new code as follows:

SECTION 2674. *Appropriations.* For the repairs, general improvements and current expenses of the State College of Agriculture and Mechanic Arts, in its several departments and chairs, and in aid of the income fund, the sum of eighteen thousand five hundred dollars is annually appropriated out of any money in the state treasury not otherwise appropriated.

The only balance to the credit of these annual funds at the beginning of the biennial period was $1,499.99 of the appropriation for experimentation in agriculture and horticulture. This amount, added to the $3,000 accruing to the fund during the biennial period, gives $4,499.99 subject to the requisition of the board. By an order of the board of trustees this fund was set aside for the use of the experiment station to be expended for the purposes specified in the law. A separate account is kept, however, with the fund. It shows expenditures to October 1, 1897, amounting to $3,959.48, leaving an unexpended balance on that date of $540.51, of which $8.40 is in the hands of the college treasurer, and $532.11 in the state treasury. Requisitions have been drawn against this balance, since October 1st, amounting to $492.91, for which, under the opinion of the attorney-general, the state auditor has no authority to issue warrants. This amount has, therefore, been drawn from the appropriation made by the new code, and appears as an item in the expenditures of that fund.

The following statement shows the amounts drawn from the state treasury on account of the other annual funds and the purposes for which they were expended. If to the amount shown therein as not drawn, $9,043, there is added the $532.11 already explained, we have $9,575.11 as the balance in the state treasury to the credit of the annual appropriations when the new code went into effect.

ANNUAL APPROPRIATIONS.

	Amounts drawn.	Balance not drawn.
Legislative act—		
Chapter 67, Eighteenth General Assembly	$ 973.25	$ 1,026.75
Chapter 126, Twenty-second General Assembly	910.06	1,089.94
Chapter 145, Twenty-fifth General Assembly	23,073.69	6,926.31
Totals under above acts	$ 24,957.00	$ 9,043.00
Amount drawn since new code went into effect	1,602.09	
Total drawn from state treasury	$ 26,559 09	

EXPENDITURES.

Blackboards in main building and agricultural hall	$ 110 35
Plastering in college building	486.91
Margaret hall—	
Fire closets	800.00
Balance due Whiting & Wood on building contract	150.00
Paid Gen. Lincoln as superintendent of construction	100.00
Furniture	1,823.85
Bake oven	750.23
Elevator	146.06
Putting slate roof on north hall addition and making other repairs on roof	892.82
Fixtures and furniture for domestic economy rooms	1,054.86
Fire escape and general repairs	263.93
Fitting up old experiment station building for servants' quarters	318.84
Main building—	
Remodeling rooms for botanical department	410 70
Oiling wood work on third and fourth floors, repairing plastering, calcimining, repairing roof, painting gutters, repairing ceilings and walls in recitation rooms and basement, purchasing locks and minor repairs	1,684 40
Creamery—	
Painting dormitory rooms	125.00
New flues in boiler, cement floor in cheese room, iron columns to support floor, painting and other repairs	1,818.11
Agricultural hall—	
Replastering and general repairs	836.28
Laboratory tables, lecture table, cases, fitting up storeroom and making other improvements in rooms of agricultural chemistry department	467.65
Farm and farm buildings—	
Repairs on farm workman's house	271.15
Repairing farm barns	970.19
Repairing farm house	1,148.20
Farm fences	250.00
Implement shed	18.00
Water connections	24.60
Greenhouse--	
Part payment on heating plant	593 12
Moving and repairing potting house addition	183.95
Tearing down old greenhouse	10 50
Morrill hall repairs	328.50
Chemical laboratory repairs, including remodeling basement, putting in air blast and repairing drain	393 83
Repairs and improvements in department of physics, including remodeling dynamo laboratory, putting in cement floor in basement of west cottage and otherwise fitting up basement for use as a physical laboratory	1,078.03
Repairing floors, replacing water pipes, painting exterior wood work and other repairs on veterinary hospital	424.71
Electric light improvements, including purchase of a new engine, remodeling power plant, and extending lighting system to creamery, agricultural hall, experiment barn, and office building	1,913.55
Painting office building, and furniture for guest rooms	236.5
Music hall repairs, including plastering, painting, enlarging chimney, and putting in furnace	509.44
Engineering hall repairs	555.30

Repair of residence occupied by Mr. McKay and addition to same	$ 927.19
Repair of residence occupied by Professor Marston	556.40
Repair of residence occupied by Professor Weems	366.83
Repair of residence occupied by Professor Franklin	219.52
Repair of residences occupied by other professors	160.20
Repair of residence occupied by foreman of horticultural department	49 00
Library railing and varnishing	187.17
College hospital repairs	54.25
Extension of waterworks	107.62
Repair of heating and electric light plant	323.61
Boarding cottage repairs	160.86
Repairing boiler plants at main building and creamery, including purchase of two new boilers	1,124.17
Furniture for recitation and other public rooms	243.69
Temporary water supply, including pump and boiler repairs, tanks in main building, and expense of making connections	229.50
Repair on boarding house	125.90
Sewer repair and improvements	199.83
Boiler inspection	206.53
Experimentation in agriculture and horticulture	492.91
Miscellaneous items, including moving of coal scales, purchase of slate, making plans of new buildings, land department expenses, changes in telephone system, repair of horticultural packing shed, and other minor repairs	171.77
Total expended	$ 26,551.58
Balance in hands of college treasurer	7.51
Total	$ 26,559.09

During the biennial period the college treasurer has been charged with the following sums drawn from the state treasury:

Amount drawn during fiscal year 1896	$ 36,912.63
Amount drawn during fiscal year 1897	37,232.10
Total	$ 74,144.73

The foregoing exhibit shows that he has paid out the following amounts on the accounts given below:

Emergency fund for deep well		$ 14,066 37
Waterworks		17,678.65
Greenhouse		6,000.00
Forge shops and foundry		1,831.41
Farm barns		3,996.68
Sewage disposal system		44.55
Annual appropriations	$ 4,452 39 26,058.67	30,511.06
Total expended		$74,128.72

This leaves a balance in the hands of the college treasurer of $16.01.

In drawing these appropriations from the state treasury, the provisions of chapter 31 of the laws of the Twenty-third General Assembly have been strictly obeyed. Money has been drawn only when needed to meet claims awaiting payment. Vouchers are on file giving in detail the expenditures on each appropriation.

The special appropriations for buildings and improvements have, in general, as shown in the foregoing statements, been expended under the contract system. Approved bonds have been required in each case. The bids, contracts, and bonds are on file in the office of the secretary of the board of trustees.

In the expenditure of the annual appropriations the following plan is pursued: The heads of the different departments report to the president, in writing, the repairs and improvements needed in connection with the buildings under their charge and the probable cost of the same. The president transmits these reports to the board with his recommendations, and the matter is then referred to the department committees. After investigation and report by these committees the board passes upon the desirability of making the improvements. If it is considered best to undertake them, they are, in general, referred to the building committee for execution, for further examination and report, or with power to execute, if the state of the fund and the demands upon it make the work advisable. In a few particular cases special committees have been appointed to take charge of improvements ordered. Ordinary emergency repairs are left to the judgment of the building committee.

In the execution of all repairs and improvements, bids are secured and contracts made, whenever the character of the work will permit. The committee in charge generally appoints a local superintendent from among the officers of the college who are available for such service. Such superintendents are held responsible for a careful supervision of the work. They generally serve without extra compensation. Those who have acted in this capacity during the past two years are Professors Marston, Bissell, and Curtiss and Steward Cavell. Bills against the appropriation are approved by the local superintendent and the chairman of the board committee; they are then passed upon by the board of audit.

The building committee, at each meeting of the trustees, reports upon the condition of the fund, the work under way, and the character and amount of the improvements ordered. Among the improvements thus listed are the following, many of which are under contract:

1. Steam heating in boarding cottages.
2. Remodeling steam heating in main building.
3. Remodeling basement of engineering building for hydraulic laboratory.

4. Casing and shelving for museum.

5. Laboratory tables and fixtures for department of entomology.

6. Cases for botanical rooms.

7. Utensil lockers for dairy department.

8. Apparatus cases for department of physics.

9. Connecting veterinary hospital with the waterworks system.

10. Painting outside walls of greenhouse and roof of potting-house addition.

11. Painting interior and exterior woodwork of physical and chemical building.

12. Sinks for junior room in chemical laboratory.

13. Water connections for physical and chemical building.

14. Painting farmhouse and two farm cottages.

15. Fitting up rooms in third floor of agricultural hall for pathological and histological laboratory.

16. Chapel tower to contain clock and bells.

17. Fitting up room in engineering building for pipe fittings and tools.

18. Boiler for power station.

19. Extension of electric light system to music hall, college hospital and other buildings.

20. Enlargement and improvement of bath rooms in main college building.

21. Repairing roof of college hospital.

22. Painting outside of creamery building.

23. Calcimining boarding cottages and dormitory rooms in creamery.

24 Painting walls and oiling floors of domestic economy rooms.

25. Painting interior and exterior woodwork of Margaret hall.

26. Painting outside of main college barn.

27. Blackboards for mathematical recitation room.

28. Fitting up room for armory.

29. Repairing ice house.

30. Repairing roof of music hall.

31. Repairing roof and inside repairs of main barn.

32. Addition to kitchen and storeroom of boarding house.

33. Wainscoting and hard pine floor in botanical rooms.

34. Repairing creamery lecture room, freshman recitation room and north end of upper hall of main building.

35. Furnishings for domestic economy rooms and recitation rooms used by Pythian and Philomathean societies.

36. Fitting up room in creamery for instruction in pasteurization and sterilization of milk.

37. Painting galvanized iron work on Margaret hall and power station.

The repairs and improvements ordered will exhaust the unexpended balance of the annual appropriation and the payments which will accrue to its credit in the reasonable future. There is, moreover, an urgent necessity for the employment of a portion of this fund to help in maintaining the college plant. The entire national support fund is needed for instruction, apparatus and department collections.

The board at its annual meeting in November, after scaling the department askings as much as it considered could be done without serious injury, was obliged to pass an order reserving $2,000 of the annual fund to cover in part the expenses of caring for the public rooms, thus relieving the national support fund to that extent. With the growth of the institution the necessity of using the fund to meet the current expenses of maintaining the plant will increase. That the national government considers such expenses should be borne by the state is made clear by its rulings regarding the use of the Morrill support fund. It is held by the department at Washington that the language of the law authorizes the purchase from this fund of apparatus, machinery, stock, and material for instruction. It is further held that "It should not be expended for heating or lighting buildings, repairs, improvements, cases, shelving, or janitor service." The annual fund was asked of the legislature with the end in view of meeting this class of expenses. It will do this if it is rightly supplemented with needed appropriations for special purposes. The trustees ask of the present general assembly appropriations for the following:

Carpenter shops	$	8,000
Purchase of books for library		15,000
Horse barn and silo		7,500
Chair of pedagogy		4,000
Residence for president		3,000
Farm improvements:		
1. Extension of main barn for implement, tool, and instruction room		600
2. Sheep barn		1,000
3. Fencing and tiling		1,500
Agricultural hall museum fittings and equipment		1,000
Mining engineering laboratory and equipment		1,000
General telephone and public grounds electric light system		1,000
Farm dairy room		875
Total	$	44,475

ENDOWMENT FUND.

As shown by the report of the secretary the college endowment amounts to $681,033.52. Under the wise management of the legislature and the successive boards of trustees it has increased since 1868 by the sum of $192,975.92. The original endowment was in the shape of land aggregating in round numbers 204,000 acres. The general assembly directed that the land should be appraised and leased on ten-year contracts, with the right of purchase at the expiration of the lease. Many lessees availed themselves of this privilege; a considerable number of leases have been renewed from time to time as they expired, and not a few, especially in the earlier years, were forfeited for non-payment of rental. It was through the reappraisement of land restored to the college under these forfeited leases, together with the transfer and investment of accumulated interest money, that the increase in the endowment fund was effected. It is to the credit of both the state and the college that this fund, which originally was exceeded in amount by that of nineteen states, is to-day in its productiveness second only to that of New York. The fund has, however, probably reached its maximum limit, as the leases now in force are too valuable to be allowed to go to forfeiture, and the expenses of the college press too closely upon its income to permit any further transfer of interest money. No change in the amount of the fund has taken place during the last biennial period. The fund as to its origin is to be credited as follows:

Congressional land grant	$591,354.01
Accumulated interest fund	89,679.51
Total	$681,033.52

The accumulated interest portion of the fund, as already stated, is due to the transfer and investment of interest money. Investments of this fund have been made in land and farm mortgages. In 1868 there was purchased with the amount then on hand 15,013.17 acres of land, located in the northwestern part of the state, at a cost of $15,926.55. This land was appraised and leased under the same plan as the congressional grant and has yielded each year an income of 8 per cent on its appraised value. The account with the principal stands as follows:

Land sold	$42,080.00
Land under lease	5,999 51
Total	$48,079 51

The balance of the fund is accounted for by direct transfers of interest money, the last of which was made in 1891.

The secretary's report shows the following as the present condition of the endowment fund as a whole:

Invested in farm mortgages	$ 592,973.63
Invested in land under lease	56,410.00
Cash balance awaiting investment	31,649 89
Total	$ 681,033.52

In regard to its management, the fund is divided as follows:

Under the direct control of the board two tracts of land obtained by foreclosure of mortgages	$ 3,618.55
Under the control of Agent Knapp, the land of the original grant and the accumulated interest fund	136,471.45
Under the control of the financial agent, W. A. Helsell, the balance of the fund	540,943.52
Total	$ 681,033.52

The original law establishing the financial agency provided simply for the investment by the financial agent of the proceeds of the congressional grant. As there was some question under the law as to whether his bond would cover loans of accumulated interest which might be made by him, a separate agency was established to handle this part of the endowment. The new code removes all objection to the loaning of the entire fund by the financial agent, and as experience has shown that it can best be handled through the machinery of that agency the board of trustees at its last meeting ordered that the two parts of the endowment be permanently consolidated and that all accumulated interest, as it shall be paid in from outstanding loans and leases, be remitted to the state treasurer, subject to the draft of the financial agent for loaning purposes.

Only a small part of the original endowment remains in the form of land. As the leases expire the principal will be paid and the land agency closed out. Thus in the near future the financial agency will come into the management of the entire endowment fund. It is, therefore, with no small degree of satisfaction that the college faces the fact that this method of handling the fund has proven eminently satisfactory. In 1883 Senator Allison secured the passage by congress of an act permitting Iowa to invest this fund in farm mortgages instead of "stocks of the United States, or of the states, or of some other safe stocks." In the discussion by the general assembly of the bill giving effect to this congressional enactment, doubts were expressed by the leading members of both houses as to the safety of this way of handling the fund. The most careful consideration was given to the proposed law, and upon the recommendation of the judiciary committee of the senate the original bill was changed in many important particulars. The measure as finally adopted has met every expectation of its advocates. The agency was established in 1884. It has made loans amounting to $886,425.80, of which $511,923.63 are now in force. Only two mortgages have been foreclosed during the thirteen years, and these resulted in the financial benefit of the college. On November 1, 1897, the unpaid interest, which had been delinquent for more than a month, amounted to $1,543.60, of which more than one-half has since been paid.

Loans are made for a term of five or ten years at 7 per cent interest. After five years from date of maturity of first interest coupon, payments on the principal, of $100 or any multiple thereof, are allowed at such times as interest matures. The borrower is also allowed to pay the principal at any time by paying in addition thereto 2 per cent per annum for the unexpired term until optional right of payment accrues. At the late meeting of the board 6 per cent loans were authorized running for eight years without optional payments. Under the law the value of the land, exclusive of the buildings, must be at least double the amount of the loan which it secures. The forms of notes, bonds, mortgages, interest coupons, and other papers are determined by the attorney-general under the direction of the executive council. The machinery of registering the loans, handling the completed papers, and collecting the interest and principal is set forth fully in the report of the secretary found under "financial reports."

The national law provides that all the expenses of the management of the endowment fund "shall be paid by the state out of the treasury of the state." The new code limits the compensation of the financial agent to be fixed by the board of trustees, to "twelve hundred dollars annually and eight hundred dollars annually in addition for assistants and sub-agents and all necessary expenses connected with the discharge of his duties." The apponitment of the agent is subject to the approval of the executive council. It is provided in his contract with the trustees that he may draw the endowment fund from the state treasury from time to time as needed, upon drafts countersigned by the secretary of the board, but that at no one time shall he have in his possession or under his control more than $10,000. He gives a bond of $50,000, under which he is responsible for the money coming into his hands and for the faithful performance of the duties of his agency, his contract containing the following stringent provisions:

He shall exercise care and diligence in making such loans, or selecting or retaining anyone to assist him in preparing abstracts of title, and if in the doing of any act in any way connected with said loans, any sum of money is lost or expense incurred, through his wilful or negligent acts or the wilful or negligent acts of his sub-agents, the said Helsell shall be fully liable to said trustees.

And the said agent shall also be liable for any want of diligence in making said loans; and for all moneys lying and being in his hands for an unreasonable time, or for any time 'where, by diligence or proper effort, the same might or could have been loaned, the said agent shall be liable for interest thereon at the rate of 7 per cent per annum.

The loans made since 1890 by the two loan agencies, now consolidated, aggregate $655,100.80, or an average each year of $81,887.60. This does not include the extensions granted. As the rate of interest declines it is reasonable to suppose that many of the outstanding loans will be paid. By the close of 1898 the right of payment under the optional clause will have accrued on loans amounting to about $250,000. It must be noted also that the loanable funds of the agency will be increased by the proceeds of the land department as land leases expire. The amount awaiting investment at the end of the biennial period, as stated, was $31,649.89.

The foregoing figures show the magnitude of the work of the agency, the importance of the interests involved, and the safe and profitable way in which, through its machinery, the endowment fund has been handled. The history of the management of the fund is submitted with confidence to the judgment of the general assembly.

THE NATIONAL SUPPORT FUND.

The national support fund consists of the income from the endowment of the college and the annual payments under the Morrill act of 1890. The additional annual fund for the maintenance of the experiment station can be used only for this purpose, and is therefore treated by itself in another part of this biennial report. A summary of the secretary's account with the educational support fund shows the following:

Cash in treasurer's hands at the beginning of the biennial period—		
Interest fund	$ 99.84	
Morrill fund	14,370 86	
Total		$ 14,470.70
Income from endowment fund, 1896	$ 46,596.05	
Income from Morrill fund, 1896	22,000.00	
Total		68,596.05
Income from endowment fund, 1897	$ 47,729.75	
Income from Morrill fund, 1897	23,000.00	
Total		70,729.75
Grand total		$ 153,796.50

The expenditures during the biennial period are as follows:

Expended in 1896 as per exhibit A attached to secretary's report		$ 66,799.29
Expended in 1897 as per exhibit B attached to secretary's report		66,079.71
Total		$ 132,879.00
Balance		20,917.50
Grand total		$ 153,796 50
Represented by cash—		
In college treasurer's hands	$ 12,917.50	
In state treasurer's hands	8,000.00	
Total		20,917.50

The receipts from the endowment fund during the last year have been above the normal because of the payment, under the improved financial conditions, of interest which had become delinquent. The balance given, which is largely to the credit of the Morrill support part of the fund, is to cover expenses on that account until the end of the government fiscal year, June 30, 1898.

The estimated income from the national support funds for the coming year is $69,000. The appropriations made by the board of trustees for salaries and department purposes are as follows:

FROM THE NATIONAL SUPPORT FUND.

For salaries as per list under "officers of instruction"—		
From interest fund	$ 12,850.00	
From Morrill fund	21,850.00	$ 34,700.00
Agricultural department—		
Current expenses	$ 1,300.00	
Foreman	600.00	
Class expenses	200.00	2,100.00
Creamery—		
Current expenses		800.00
Dairy—		
Salary of Mr. McKay	$ 1,200.00	
Assistant	200.00	
Winter dairy school	150.00	1,550.00
Horticultural department—		
Current expenses and experimentation	$ 800.00	
Heating and stocking greenhouse	400.00	
Assistants	400 00	1,600.00
Veterinary department—		
House surgeon	$ 200.00	
Current expenses and apparatus	350.00	550.00
Pathological department—		
Current expenses and apparatus		75.00
Civil engineering department—		
Assistant	$ 300.00	
Current expenses and equipment	823.15	1,123.15
Mechanical engineering department—		
Assistants	$ 3,100.00	
Current expenses and equipment	1,300.00	4,400.00

Physics and electrical engineering—			
Assistants		$ 900.00	
General expenses and apparatus		1,059.10	$ 1,959.10
Mining engineering			100.00
Military tactics—			
Current expenses		$ 200.00	
Flags		30.00	230.00
Agricultural chemistry—			
Assistant, current expenses, and apparatus			500.00
Department of chemistry—			
Assistants	$ 650.00		
	300.00	$ 950.00	
Current expenses and apparatus		600.00	1,550.00
Entomology and zoology—			
Current expenses, mounting specimons, zoological collection and department apparatus		$ 700.00	
Exchange of typewriter		65.00	765.00
Botany—			
Assistants		$ 350.00	
Current expenses and apparatus		428.91	
Heating office room		25.00	803.91
Mathematics and secretary's office—			
Assistants and clerk hire			1,450 00
Political economy			100.00
Domestic economy—			
Current expenses		$ 350.00	
Furnishings for room		50.00	400.00
Department of music—			
Salary of director		$ 400.00	
Instrumental music at public exercises		100.00	
Current expenses		40.00	
Music for Sabbath services		50.00	590.00
Library—			
Librarian		$ 600.00	
Assistant librarian		350.00	
Expenses, books and periodicals		1,800.00	2,750.00
Sabbath services			450.00
Public grounds			1,800.00
Public rooms—			
Furniture		$ 450.00	
Heating, lighting and janitor service		2,700.00	3,150.00
Contingent expense—			
Private secretary for president's office		$ 625.00	
Catalogues, printing, stationery and advertising		2,750.00	
Extra fund for advertising		1,000.00	
Advertising in Student		50.00	
Junior Annual, advertising for 1898, the Annual to contain nothing not approved by the president		50.00	
Telephone service		80.00	
Ringing bell for recitations		75.00	
Mail service		270 00	
Proctors		400.00	
Preceptress fund		150.00	
Address before college and trustees		100.00	
Pumping pipe organ		25.00	
Clerks for treasurer's office $900.00 (paid from steward's department $600.00)		300.00	
Annual fee for Agricultural college associations		10 00	
Fund for attending teachers' institutes and associations			

(intended for president and professors authorized by president to attend such meetings)	$ 70.00	
Emergency fund	150.00	
Department of English literature and history	50.00	
Commencement write-up	20.00	
Music books for chapel	100 00	
Dictionaries for office use	25.00	
Physical culture for ladies	125.00	
Stenographer for commencement	14.22	
Piano trucks	25 00	$ 6,464.22
Grand Total		$ 69,460.38

In addition to the above there was appropriated to the different departments the proceeds of the ordinary sales made during the year.

It will be noticed that the appropriations exceed the estimated income from the national support fund. Other appropriations will need to be made during the year. It was to meet this excess that the board reserved, as already explained, the sum of $2,000 from the annual appropriation by the state, to cover, if necessary, that much of the current expense of maintaining the college plant.

An analysis of the appropriations will show the following classes of expenses:

Salaries charged to salary account	$34,700	
Salaries of assistants charged to departments	11,150	$ 45,850.00
General expenses of the college		9,614.22
Current expenses of departments		8,446.16
Furniture for public rooms		450.00
Total for salaries and current expenses		$64,360 38
Additions to department collections and apparatus		5,100.00
Total		$69,460.38

The foregoing figures develop the fact that the institution, with its present income, is able to add but slowly to its permanent facilities for instruction. It ought to grow much more rapidly in this direction.

The following are the more important of the regulations of the board of trustees governing the expenditure of these appropriations:

1. Appropriations to the departments are expended by the officer in charge, acting under the general direction of the president of the college. Approved bills for such expenditures are presented to the board of audit, which board is directed not to allow any bill unless the same shall contain the date at which the goods were purchased or the service rendered, and such full and itemized statement of the subject matter as will furnish the board of audit and the board of trustees sufficient grounds for determining the propriety of allowing or disallowing the claim. The bill, when audited, is paid by the college treasurer, and the receipted bill is filed as his voucher.

2. The head of each department is required to keep a current and accurate memorandum of all appropriations to his department, and of all orders which he may issue against the same. It is directed that no obligation shall be incurred in excess of such appropriation. If such case occurs, the secretary is required to submit a list of the excess bills, and the payment of the same is forbidden unless the department has outstanding collections, in which case said collections, as paid in, can be applied upon the bills. For the balance, the head of the department is held personally responsible. In no case is the board of audit allowed to audit bills in excess of the appropriation to the department.

3. All departments employing labor are required to keep a permanent and itemized book account of dates of all services, character of service, and hours employed each day, to be open on call to the inspection of the board of audit.

4. Departments deal with each other as with outside parties, except that the bills of one department against another are treated as preferred claims against the appropriation to that department. In case any head of a department, receiving a bill against his department in favor of another department of the college, fails to present the same to the board of audit within five days after written notice of such bill has been given him by the treasurer, the treasurer shall consider such bill approved. He shall thereupon make indorsement to this effect upon the bill and submit the indorsed bill to the auditing board for audit in the usual way.

5. The head of each department is directed, at the time of filing his annual financial statement, to file an inventory with the secretary of all apparatus, books, stock, feed, machinery, or other articles belonging to the college in this department.

6. It is the duty of the standing committees of the board to investigate the needs of the departments under their charge, consider and report upon appropriations recommended by the president, and supervise their expenditure as they deem best. At the close of the year each committee is required to examine the vouchers, inventories, and accounts of the department under its charge, inquire fully into the amount and character of expenditure of each and make such report thereon as shall give the board full information concerning the financial management of the respective departments.

OFFICERS OF INSTRUCTION.

The last biennial report contains a list of the officers of instruction for 1896 with their salaries. A vacancy arising in the chair of domestic economy, the faculty committee and the president of the college were authorized to fill the same. They employed Miss Gertrude Coburn of Kansas City, Kan , at a salary of $1,200. She was formally elected by the board at its meeting in May, 1896.

Miss Marie Chambers having been relieved, at her own request, of the work of instruction in elocution, Mr. A. M. Newens of Des Moines, was elected to the vacancy. His salary was fixed at $600, his term of service to begin March 1, 1896. Miss Chambers' resignation as director of music was presented to the board at its May meeting. Upon the recommendation of

President Beardshear, Mr. F. J. Resler, of Mount Vernon, Ohio, was chosen to succeed her. He was allowed to appoint the instructor in instrumental music subject to the approval of the president. The salary of Miss Ford, professor of French and German, was increased for the school year of 1896, from $900 to $1,000. She resigned in August of that year to accept a position in the schools of Minneapolis. Miss Lizzie M. Allis was elected to the vacancy at the same salary paid Miss Ford. No other changes in the list of instructors occurred during 1896.

In February, 1897, Prof. James Wilson, having accepted the position of secretary of agriculture in the cabinet of President-elect McKinley, tendered his resignation as professor of agriculture and director of the experiment station. The resignation was not accepted, but the professor was given an indefinite leave of absence without salary. The following resolutions were adopted by unanimous vote:

WHEREAS, The Hon. James Wilson, professor of agriculture and director of the experiment station of this college, has been called to fill the honorable and important position of secretary of agriculture in the cabinet of President McKinley;

Resolved, That the board of trustees of the Iowa State College of Agriculture and Mechanic Arts express their appreciation of the valuable services rendered the college by Professor Wilson during his years of connection with the institution, and the high standing his personal popularity and known merits as a man of character and agriculturist of practical and common sense ideas have given to this college among the farming classes and all interested in progressive and industrial education in Iowa.

Resolved, That we commend the wisdom of President McKinley in calling Professor Wilson to the broader field where his experience as a man of affairs and judgment of men and policies may be helpful in the administration of government, and where his knowledge of agriculture from a scientific and practical standpoint may contribute to the material and educational upbuilding of the agricultural interests of the country.

Resolved, That while we deeply feel the loss entailed to this institution by his withdrawal for the time being from active service as a member of its faculty we congratulate the president in the choice of so wise a counselor, and the country in securing the services of so capable a public servant.

Prof. Charles F. Curtiss was advanced to the work left vacant, during the absence of Professor Wilson, under the title of professor of agriculture and director in charge of the experiment station. Later in the year Professor Wilson was given the title of "dean of the agricultural faculty," while the title of Professor Curtiss was changed to professor of agriculture and director of the experiment station. The salary of Professor Curtiss was fixed at $2,000 and the use of the farm house; $605 of his salary was ordered charged to the Morrill support fund and the balance to the experiment station. He was given two assistants at a salary of $600 each, the aggregate salary to be divided equally between the Morrill and the station funds. Mr. J. W. Wilson was appointed as one assistant, while temporary arrangements were made regarding the other. At the May meeting James Atkinson, who had been connected with the Agricutural college at Guelph, Canada, was elected as the second assistant at a salary of $800, the extra $200 to be charged to the station account.

At this May meeting, Miss Flora Wilson resigned as college librarian. Miss Vina Clark was elected for the remainder of the year, at the expiration of which time, having rendered satisfactory service, she was re-elected, to serve as other officers. Her salary was fixed at $600. Miss Effie Curtiss, assistant libraran, having resigned in May, Miss Edith Foster was appointed to that position. At the close of the year her salary was advanced to $350.

In June, 1897, Prof. W. S. Franklin, professor of physics and electrical engineering, under the inducement of a larger salary and a wider field of usefulness in a similar position in Lehigh university, tendered his resignation. An arrangement was made with the professor under which he consented to continue at the head of the department until September 1st, and in the meantime, by conducting classes during the summer vacation, to finish up the work of the senior class in electrical engineering. Mr. L. B. Spinney, the assistant professor of physics, was selected to fill the vacancy. He was voted $150 additional compensation for the remainder of the year while his salary, beginning with March 1, 1898, was fixed at $1,500 per annum. He was allowed an assistant for the remainder of the year. and in making arrangements for 1898 was granted an assistant's fund of $900, with which to employ two assistants if he thought best. The house formerly occupied by Professor Franklin was assigned to Professor Bissell.

At the annual meeting of the board in November last the salary of Professor Beyer, assistant professor of geology, was increased from $1,200 to $1,300. The professor was away from the college during the last half of the year on leave of absence to study in Europe. The expense of employing other parties to instruct his classes was borne by the professor.

The resignation of Mr. J. W. Wilson, to take effect November 15th, was presented and accepted. Mr. John A. Craig, who had won an enviable reputation in connection with the agricultural department of the Wisconsin university, was elected professor of animal husbandry at a salary of $1,800, thus greatly strengthening the agricultural side of the college.

With the changes mentioned the salary roll for the school year of 1898 will stand as follows:

SALARIES FOR 1898.

W. M. Beardshear, A. M., LL. D.	$ 3,850
President.	
Psychology and ethics.	
M. Stalker, M. Sc., V. S	1,600
Veterinary science.	
Station veterinarian.	
J. L. Budd, M. H	2,000
Horticulture.	
Station horticulturist.	
E. W. Stanton, M. Sc	2,200
Mathematics and economic science.	
Secretary board of trustees.	
General James Rush Lincoln	1,800
Military science and tactics.	
Mining engineering.	
Alfred A. Bennett, M. Sc.	1,600
Chemistry.	
Herbert Osborn, M. Sc	1,600
Zoology and entomology.	
Station entomologist.	
W. H. Wynn, Ph. D., D. D	1,800
English literature and history.	
L. H. Pammel, B. Agr	1,800
Botany.	
Station botanist.	
Miss Gertrude Coburn, B. Sc	1,200
Domestic economy.	
C. F. Curtiss, B. Agr	2,000
Agriculture.	
Director of experiment station.	
J. B. Weems, Ph. D	1,600
Agricultural chemistry.	
Station chemist.	
Miss Margaret Doolittle, A. B.	900
English, Latin, and rhetoric.	
L. B. Spinney, B. M. E., M. Sc	1,500
Physics and electrical engineering.	
G. W. Bissell, M. E	1,600
Mechanical engineering.	
A. Marston, C. E.	1,600
Civil engineering.	
Miss Lizzie May Allis, B. A., M. A	1,000
French and German.	
Mrs. Sally S. Smith, B S	750
Preceptress.	
W. E. Harriman, B. S., M. D	1,000
Pathology, histology, and therapeutics ($1,000).	
College physician, $300 paid from hospital fees charged students.	
W. B. Niles, D. V. M.	1,700

Veterinary science.		
W. H. Meeker, M. E.	$	1,400
Mechanical engineering.		
A. M. Newens		800
Elocution and English.		
S. W. Beyer, B. S., Ph. D.		1,300
Geology and zoology.		
John A. Craig, B. S. A.		1,800
Animal husbandry.		
James Atkinson, B. S. A.		800
Assistant in station.		
Herman Knapp, B. S. A.		1,100
College treasurer and recorder $850. Station treasurer $250.		
Total	$	40,300

Houses on the college grounds are occupied by Professors Bennett, Osborn, Curtiss, Marston, Bissell, Weems, and Stanton. The inside repair of these houses is chargeable to the occupant. Their annual rental value is considered by the board to be equivalent to $200. Aside from house rent no perquisites are allowed, the rule of the board in this regard reading as follows:

> No professor, instructor, assistant, or any employe of this college shall have or enjoy over and above his or her regular salary any extras or perquisites of any kind whatever either directly or indirectly.

All bills in favor of salaried officers, other than regular salary payments, are passed upon by the board in session. No leave of absence is granted to any officer under pay unless satisfactory arrangements are made by him for the performance of his duties without extra cost to the college.

The salaries included in the salary list are chargeable, under the order of the board, to the following funds:

Morrill fund	$	21,850
Interest fund		12,850
Experiment station fund		5,600
Total	$	40,300

No other charges are made against the Morrill fund, it thus being used entirely for the purposes of instruction. The charge against the experiment station is considered to be the equivalent of service rendered. It includes $1,350 of the salary of Director Curtiss; $900 each of the salaries of Professors Weems and Craig; $300 each of the salaries of Professors Budd, Pammel, and Osborn; $500 of the salary of Dr. Niles; $800, or all of the salary of Mr. Atkinson; and $250 of the salary of Treasurer Knapp.

COLLEGE TREASURER.

The college treasurer is elected annually. His duties are manifold. He receives and receipts for all moneys arising from the income of the endowment fund, appropriations of the general assembly, sales of the products of the farm, creamery, experiment station, and other departments, payments by students of room rent, hospital and laboratory fees, board, fires, lights, and other charges, and for money arising from all other sources. He pays out the same on bills properly audited, retaining the receipted bill as his voucher. He keeps a complete set of double-entry books, in which an account is kept with each department in such a way as to show in full its receipts and expenditures. He keeps the cash reports and vouchers for the different departments independent of each other so that any party interested can examine the accounts of a single department without confusing them with those of any other. The treasurer makes out bills against parties owing the departments, collects the same, and makes cash reports which are verified by the heads of the departments on whose accounts the collections are made. He checks his books monthly with those of the board of audit, and makes settlement with the board of trustees at the close of each fiscal year. The station account is checked annually with the government inspector. Annual reports of the Morrill support fund are made to the department of the interior, and of the experiment station account to the department of agriculture. Annual reports are made to the board of trustees and a biennial report to the governor of the state.

The treasurer receives deposits of students and pays checks against the same. The deposits last year numbered 1,700 and the checks cashed 3,105. The receipts issued on all other accounts exceeded 10,500 and the vouchers for the year numbered 5,010, some of which, being pay-rolls, involved payments to several parties, rising, in the case of the creamery accounts, to 150 different persons on a single voucher.

The treasurer, Mr. Herman Knapp, has also acted as land and loan agent, having charge of the renting of endowment fund land and the loaning of the accumulated interest fund. In this capacity he has given much time to the making of leases and loans and the collecting of principal and interest, all of which he has reported to the secretary of the board, turning over the cash collected to the state and college treasurers.

The treasurer has supervision of the college book department, making all orders for books and stationery sold students, receiving and settling for express, and arranging for and over-seeing the distribution of the student and department mail. As recorder he makes record of the class standing of each student, reporting the same at the beginning of each term to the student, and furnishing to the president and faculty the information upon which undergraduate classification and the right to graduation are determined.

The heavy burden of work in the treasurer's office, was one, though not the most important, consideration leading the board to transfer to the financial agency the loaning of the accumulated interest part of the college endowment.

The methods of testing the accuracy of the treasurer's accounts are discussed in detail in the report of the secretary. The following are worthy of special mention:

1. The close watch kept upon each department account by the officer in charge, who is interested in realizing for his department the full benefit of the appropriation made for its use.
2. The examination made each year by the government inspector.
3. The comparison after each monthly trial-balance of the treasurer's books with those of the secretary. This in itself would detect any errors.
4. The annual examination and settlement with the treasurer made by special committee of the board of trustees.

This special committee in 1896 was composed of Trustees Dunbar and Smith, who reported that they had carefully examined and compared the receipts and vouchers with the debit and credit side of the treasurer's cash account and found the same correct. They added, "We found the books in clean and splendid condition, and we cheerfully certify that Treasurer Knapp has performed his duties to the complete satisfaction of your committee." The cash balance shown was counted and found correct.

Trustees Dixon, Hungerford, Robinson and Smith constituted the special committee making the settlement in 1897. The following is their report:

To the Board of Trustees of the Iowa State College:

Your committee appointed to make settlement with the treasurer respectfully report that they have examined the duplicate receipts for money received by him, checked his vouchers with his account, tested his balances, and are pleased to report that his accounts are correct.

Your committee finds the treasurer properly charged with the sum of $20,919.25, divided among the different accounts as follows:

General accounts	$	16,858.23
Steward's funds		1,114.86
Laboratory fees		4.50
Students' deposits		2,940.16
Balance due on collections		1.50
Total	$	20,919.25

Respectfully submitted,

W. J. Dixon,
J. B. Hungerford,
L. B. Robinson,
Hamilton Smith.

The report was entered on the records and the committee continued to determine balances and count cash at time of filing new bond. This duty was performed by the chairman of the committee, Mr. Dixon, who, upon the authority of the board, certified to the secretary of state that the treasurer had produced and accounted for all the money and property chargeable to his account.

Mr. Knapp was elected treasurer for the ensuing year. His bond, the amount of which was fixed by the board at $50,000, has been filed with the secretary of state and approved by him. The salary of Mr. Knapp, guaranteed by the board, is $1,500, payable from the following sources:

Steward's department	$	100
Book department		150
Experiment station		250
Land department fees		150
Interest fund		850
Total	$	1,500

He is allowed $900 as office clerk hire, of which $600 is for keeping the books of the steward's department and is paid from the income derived from the students. The entire cost of his office to the college funds proper is $1,550.

EXPERIMENT STATION.

In 1887 congress passed an act establishing experiment stations in connection with agricultural colleges. An annual appropriation of $15,000 was made to each college for their support. The use of the fund is limited under the most stringent provisions to such experiments as bear directly upon the agricultural industry. Each station is inspected annually by a government inspector to the end that it may be held to an exact compliance with the law. It is only incidentally that the station helps the educational work of the college. The annual appropriation for its maintenance is therefore treated separately from the educational support funds. As in the case of the other departments the income from the sale of products is added to the appropriation. The account with the station for the biennial period shows the following receipts and disbursements:

RECEIPTS.

Cash on hand at the beginning of the year 1896		$ 313.95
Congressional appropriation for 1896	$ 15,000.00	
Sale of products	3,308 03	
Total		18,308.03
Congressional appropriation for 1897	$ 15,000 00	
Sale of products	3 203.26	
Total		18,203.26
Total		$ 36,825.24

DISBURSEMENTS.

Expenditures during fiscal year 1896	17,396.28
Expenditures during fiscal year 1897	19,407.15
Total disbursements	$ 36,803.43
Balance on hand at the close of the biennial period	21.81
Total	$ 36,825.24

The inventory of station property amounted to $3,553.10. In addition to the congressional appropriation the board has for the last few years set aside for the use of the station the annual appropriation of $1,500 for experimentation in agriculture and horticulture made by the Nineteenth General Assembly. The expenditure of this appropriation is discussed under the head of "state appropriations." In the form mentioned it is repealed by the new code.

The experiment station is managed by a board of direction, consisting of the president of the college, the director of the station, and such professors as are connected with the station work. It is the duty of this board of direction to recommend to the board of trustees at its annual meeting in November a proper division of the funds among the various departments of the station according to the work they are expected to do. The time covered is the government fiscal year, ending June 30th. The division made in November, 1897, includes the state appropriation of $1,500, payable on the first of last May, and is as follows:

DIVISION OF EXPERIMENT STATION FUND FOR 1897-98.

1. Salaries of station staff, as already given under salaries of officers		$ 5,600
2. Salaries of assistants—		
Assistant for chemical section	$ 400	
Assistants for botanical section	300	
Assistant for horticultural section	600	
Assistant for dairy section	400	
Assistants for entomological section	400	
Total		2,100
3. Bulletins for printing and distribution		3,500

4. Appropriations for sections—				
Botany	$	312		
Horticulture		200		
Entomology		390		
Chemistry		585		
Veterinary science		390		
Dairy		488		
Agriculture, including labor and all contingent expenses		1,710		
Total			$	4,075
5. General expenses—				
Heating of building and janitor service	$	470		
Mail and express		100		
Stenographer		360		
Water		100		
Total				1,030
6. Building fund repairs and improvements				195
Total			$	16,500

The experiments conducted during the last two years, and the work outlined for the coming year, are set forth in full in the reports of the station staff, found in another part of this biennial report. The small balance on hand in November compelled a limitation in the work of the station in order that the expenditures for the year might, without question, be brought within the income.

When agricultural hall was completed some of the station staff were given rooms in the new building. A question having arisen as to the right of the college to use the building formerly occupied by them, which was built with experiment station funds, for other than experimental purposes, the following resolution was adopted by the board of trustees and ordered entered of record:

> WHEREAS, The removal of the experiment station to its new quarters in the agricultural hall erected by the state provides for the station, in lieu of its former building, more commodious and better equipped apartments; and whereas, it is for the best interests of the experiment station that its quarters be as now established;
>
> *Resolved,* That the interests of the experiment station in the buildings upon the college grounds be, and the same are hereby, transferred from the former building of the station to its present apartments, and that the former building be henceforth devoted to such other college uses as may be determined upon.

AGRICULTURAL DEPARTMENT.

The standing committee of the board having general oversight of the farm is composed of Trustees Schermerhorn, Stout, Smith, Dixon and Saylor. It is the duty of the committee to make itself familiar with the general plan under which the department is conducted, examine into its receipts and disbursements, check up its inventories, consider the recommendations of the professor in charge, and make report to the board of its condition and needs. In performing this duty the committee makes use of the bills of the department in the treasurer's office, which give in full the purchases made and the labor employed; the cash reports filed with the secretary, which contain an itemized statement of the amount and kind of property sold, the date of sale, the party to whom sold and the price received; and the farm inventory, which is so arranged as to give a history of the purchase and sale of stock, births, deaths, etc., and the purchase and sale or use of farm machinery and other department property. The reports of the committee, made at the annual meetings of the board, show that all articles charged against the department have been accounted for and that the values fixed in the inventories are reasonable in amount. The committee further say: "Notwithstanding the farm has suffered from the scourge of hog cholera, the inventory has increased; by selection, culling, breeding and buying a high grade of pedigreed and recorded animals now compose our college herds, the equal in merit of any in the state; extensive improvements, in the way of clearing up brush and timber lands, fences, tiling, etc., have been made; and on the whole the farm was never in a more satisfactory condition than at the present time." The committee reports the following receipts and expenditures for the biennial period:

Total cash expenditures for 1896	$ 4,095.41	
Total cash expenditures for 1897	7,529.35	
Total		$ 11,624.76
Total cash receipts for 1896	$ 2,650.36	
Total cash receipts for 1897	6,275.60	
Total		8,925.96
Net cash expenditures		$ 2,698.80
Inventory for 1897	$ 14,249.83	
Inventory for 1895	13,797.89	
Increase in inventory		451.94
Cost of maintaining the farm for the two years		$ 2,246.86

The college farm, in common with the agricultural industry in general, has felt the business depression of the last two years. The hog cholera has been an additional factor reducing its income. But especially should it be borne in mind, in considering the financial showing, that its main purpose is not commercial, but experimental and educational. The two purposes can not be separated nor can the educational feature be brought to a commercially profitable basis. While it is the aim of the board that the farm shall be managed upon business principles and with the strictest economy, it is to be expected that like other educational departments it will require an appropriation for its support.

At its meeting in May, 1897, the board decided to sell a portion of the farm lying north of Squaw creek, which had proven unavailable for farm purposes. The tract, comprising about 85 acres, was disposed of to Mr. J. E. Campbell for the sum of $3,625. A payment of $2,000 was made in cash; the balance is to be paid on or before March 1, 1898, whereupon delivery of deed is to be made. Since the land was purchased in 1870 with accumulated interest money it was directed that the proceeds of the sale be credited to that fund. In lieu of the land sold, the board asks the legislature for authority to purchase with the college endowment a tract of not more than 80 acres which shall be more conveniently situated for ordinary farm and experimental purposes.

CREAMERY.

The following is the financial showing in this department for the biennial period:

Cash expenditures for 1896	$ 19,828.47	
Cash expenditures for 1897	21,678.48	
Total		$ 41,506.95
Receipts for 1896	$ 18,795.82	
Receipts for 1897	20,486.42	
Total		39,282.24
Excess of expenditures over receipts		$ 2,224.71
Inventory for 1895	$ 1,468.64	
Inventory for 1897 including collections due	691.31	
Decrease in inventory		777.33
Net cost of maintaining the creamery for the two years		$ 3,002.04

The above includes a loss of $1,200 arising through the failure of Douglass & Co., commison merchants of New York city. Deducting this, the cost of maintaining the department for the two years is $1,802.04, or in round numbers, $900 per year. This is much less than the cost of similar departments in the colleges of other states where the commerical idea is not introduced. The commercial feature not only reduces the expense, but adds to the practical character of the instruction given.

COLLEGE LIBRARY.

Upon the recommendation of the committee on library it was ordered by the board that the annual appropriation to that department be apportioned as follows:

1. Ten per cent thereof shall be placed under the control of the department to meet emergencies.

2. Ten per cent may be expended by the librarian for general works under the direction of the library committee of the board.

3. The sum of $300 shall be set aside for the general expenses of the library.

4. The faculty shall meet in April and October of each year for the purpose of considering the library and its needs. At such meeting each head of department shall submit his or her list of desired works for review by the faculty, and from the lists submitted a final list shall be prepared and apportioned by the faculty and submitted to the library committee of the board for consideration at the May and November meetings of said board. The available fund shall then be divided among the various departments.

5. Balances unexpended on the 1st of October, in each year, shall be at the disposal of the librarian to be spent under the direction of the library committee of the board.

In making additions to the library, prices are secured from a number of leading firms. During 1897, 505 volumes were purchased. An invoice of all property in the department is made at the close of each year. The invoice taken in November shows a total of 11,458 volumes, classified as follows:

General works	904
Philosophy	331
Religion	357
Sociology	1,772
Philology	201
Natural science	2,863
Useful arts	1,394
Fine arts	499
Literature	1,640
History	1,497
Total	11,458

The committee report the library in excellent condition, and commend most highly the work of the librarian, Miss Clark, and her assistant, Miss Foster.

OTHER COLLEGE DEPARTMENTS.

The plan proposed by Professor Budd of closing out the nursery stock of the horticultural department after 1898, except limited sales from accumulated surplus, was approved by the board. The future policy of the department was left to the farm committee and the head of the department for determination. The employment of a florist for the new greenhouse was deferred, and in the meantime Professor Budd and Foreman Sexton were charged with its care.

The grove in the southwest corner of the college grounds, and a part of the field now used as a pasture by the veterinary department, were added to the college campus. The college park was also included under the same management as the college grounds.

A contract was entered into with the Hartford Steam Boiler and Inspection company in which said company agrees, for the sum of $288, to inspect and insure during the term of three years, twelve boilers, located in the different college buildings. The boilers are to be inspected at least twice each year and a written report of their condition furnished the college after each inspection. If an additional boiler is placed in the power house it is to be inspected and insured without additional cost. The total insurance is $28,800, divided as follows:

Power house	$ 8,000
Main building	8,000
Margaret hall	5,000
Agricultural hall	2,800
Creamery	5,000
Total	$ 28,800

The professors in charge of the departments of music and elocution are allowed by the board of trustees to charge certain fees for instruction given by them which is not included in the college courses of study. In order that the board might have knowledge of the compensation received by these officers in this connection, it was directed that all fees forming part of such compensation, or used to meet the expenses of these departments, should be paid directly to the college treasurer on bills of collection furnished by the heads of these departments. The amounts collected were ordered paid over to these officers, when entitled thereto, upon bills audited in the usual way by the board of audit.

THE COLLEGE BOARDING DEPARTMENT.

This department is conducted by the college for the benefit of the students. The trustees decide upon the general plan of its control and are responsible for all the details of its management. They establish the price of board, elect the steward, fix his salary, and specify his duties. The college virtually guarantees the payment of its obligations and is the probable heir of its assets. It has, however, for years, been self-sustaining.

The present steward, Mr. J. F. Cavell, was appointed in 1895. His salary is $1,000 per annum, and board, room, fires and lights for self and wife during the two college terms and for such time during vacation as the board may decide that the department needs his services. Under his efficient management the department has prospered financially and has given satisfaction. The following statement shows its receipts and disbursements during the last two years:

RECEIPTS.

From students and others in 1896	$ 20,980 09	
From students and others in 1897	21,683.18	
Total		$ 42,663.27

DISBURSEMENTS.

Paid for labor and supplies in 1896, including debit balance of $19.23 at beginning of the year	$ 20,756.19	
Paid for labor and supplies in 1897	21,349 56	
Total		42,105.75
Excess of receipts over disbursements		$ 557.52
Collections due	$ 520.02	
Bills unpaid	414.61	
Balance		105.41
Supplies on hand		61.75
Balance to credit of department		$ 724.68

The board ordered that—

The old experiment station building left vacant by the removal of the station offices to agricultural hall should be removed to a location back of Margaret hall, thoroughly repaired, supplied with a water-closet system and bath-rooms, steam heating and electric lights, and then assigned to the boarding department as a servants' hall. The improvements ordered were made at a cost of $1,359.94.

The steward was given power to suspend any student from the privileges of the dining room whose conduct was such as to disturb its good order.

It was directed that students, with the consent of the president, be permitted to board and room outside of the college, but that no student be permitted to room in the college buildings and board outside.

DEPARTMENT OF FIRES, LIGHTS AND INCIDENTALS.

The income of this department is derived from the following sources:

1. Payment of 70 cents per week by students rooming in the boarding cottages.
2. Payment of 85 cents per week by students and teachers rooming in the other college buildings.
3. Payment of $5 per term by students boarding outside of the college.
4. Sales of coal to residents of the college campus, for their convenience and to the slight profit of the department.

5. Payments by the college from its support funds of an amount sufficient to balance the account.

The expenditures may be classified as follows:

1. Heating and lighting the college buildings.
2. Water supply and janitor service for these buildings.
3. Incidental expenses, such as distributing the students' mail, and the stationery and clerk-hire of the department.

Steward Cavell has charge of the janitor service in the college dormitories; President Beardshear of the heating, lighting and janitor service in the office building; Professor Osborn of the janitor service in Morrill hall; Professors Bennett and Spinney of the janitor service in the chemical and physical laboratories; Treasurer Knapp of the distribution of the students' mail; and Professor Bissell of the purchase of coal, employment of firemen, and all other matters not included in the assignments previously mentioned.

All collections are made by the college treasurer and claims against the department are paid by him upon bills properly audited.

The following are the receipts and expenditures for the biennial period:

RECEIPTS.

From students and others, 1896	$ 11,015.03	
From students and others, 1897	10,547.66	
Total		$ 21,562.69
From college support fund, 1896	$ 3,350.00	
From college support fund, 1897	2,625.30	
Total		5,975.30
Total receipts		$ 27,537.99

EXPENDITURES.

For supplies and labor during 1896	$ 14,354 95	
For supplies and labor during 1897	13,183.04	
Total expenditures		27,537.99

The payments by the college from its support fund are considered to be a fair equivalent for heating, lighting and care of the library, museum, chapel, recitation and other public rooms. With the end in view, however, of reducing these balances as as much possible the board directed at its last meeting that a separate expense account should be kept with each building on the grounds, showing all items of expense incurred on this account during the year. A form of expense sheet was adopted, and the officers in charge directed to report to the board at least twice a year.

The following orders were adopted relating to this department:

1. Repairs of heating and lighting plant shall be charged to the state repair funds.
2. The expense of heating and lighting the dining-room, kitchen, and servants' quarters shall be charged to the fires and lights account.
3. Any excess in the piano rental fund, after paying the expense of tuning pianos, shall be credited to the fires and lights account, in order that such excess may be used in heating and lighting music hall.
4. Electric lights shall be furnished during the winter to the office building, the creamery, and the farm barns.

ROOM RENT.

The room rent charged against students and others is $3 per term. The fund thus obtained is used by the board in repairing buildings and purchasing furniture for the student dormitories.

The following exhibit shows the receipts and expenditures during the last two years:

RECEIPTS.

Balance on hand at the beginning of the biennial period		$ 416.75
Received from students and teachers 1896	$ 1,966.55	
Received from students and teachers 1897	2,008 53	
Total		$ 3,975.08
Total available fund		4,391 83

EXPENDITURES.

Main building--		
Furniture for student rooms, 100 iron beds, 60 oak wardrobes and 9 tables	$ 910.50	
Other furniture	22.25	
General repairs	382 12	
Total		1,314.87
Boarding cottages repairs		106.85
Margaret hall--		
Cistern	$ 213.27	
Carpets, 421¾ yards, for halls	345.56	
Screens for domestic economy rooms and third floor	64.85	
General repairs	157.10	
Total		$ 780.78
Servants' hall--		
Remodeling and repairing old experiment station building for servant quarters, including painting, replastering, plumbing, and making connections with heating, electric light, and water systems		$ 1,041.11
Wages of general carpenter working on dormitory buildings		305.60
Cost of sinking well in 1895 near engineering hall in attempt to secure water supply		280 88
Sewer repairs		34.95
Repairs on college hospital		29.53
Repairs on various buildings		126.28
Total expended		$ 4,020.85
Balance on hand		370.98
Total		$ 4,391.83

It is the design of the board of trustees to hereafter confine the expenditures of this fund to the purchase of furniture for student rooms and the repair of student dormitories. The steward was directed to keep an account with the furniture in each of the student and public rooms. A special form of inventory book was purchased for this purpose.

The board ordered that a rental of $4 per month be charged for each of the three front and center south rooms and $3 each for the two west rooms on the second floor of the office building.

MATTERS RELATING TO STUDENTS AND DEGREES.

The important changes in the requirements for admission and in the courses of study recommended by the faculty were approved by the board. The changes are fully set forth in the report of President Beardshear.

The expenses charged against the students remain the same as in the last biennial report. As there stated, the entire cost to a student entering college, of board, fires, lights, laundry, books and incidentals for the school year of thirty-three weeks will be from $140 to $150, according to the course of study chosen. The expense to students of the higher classes will be somewhat in excess of these amounts, owing to the laboratory fees and the greater cost of the books used.

The number of students graduating in the different college courses during the biennial period is as follows:

	1896	1897
In the course in agriculture	8	6
In the course in science relating to the industries	22	19
In the course in mechanical engineering	4	2
In the course in civil engineering	6	6
In the course in electrical engineering	3	11
In the course in mining engineering	..	1
In the ladies' course	5	9
In the course in veterinary science	..	1
Totals	48	55

Appropriate degrees were conferred upon these graduates.

The degree of master of science (M Sc.) was conferred upon Emma E. Pammel, C. B. Weaver, Emma F. Sirrine, S. C. Hutchison, H. C. Irish and G. I. Miller; the degree of master of agriculture (M. Agr.) upon C. F. Curtiss, G. W. Carver, C. D. Reed, W. S. Hayes and E. E. Faville, and the degree of master of scientific agriculture (M. Sc. Agr.) upon C. H. Eckles and C. W. Louthan.

At the meeting of the board in November, 1897, the degree of master of scientific agriculture (M. Sc. Agr.) was, by unanimous vote, conferred upon Hon. James Wilson.

Respectfully submitted,

E. W. STANTON,
Secretary.

DEPARTMENT REPORTS.

UNIV. OF CALIFORNIA

THE FARM.

C. F. CURTISS, PROFESSOR.

The college farm consists of about 800 acres and constitutes a part of the equipment for the instruction in agriculture. The farming and pasture land is located on either side of a small stream known as "Squaw creek," and the tillable land represents a wide variety of soil, ranging from the rich bottom loam to upland prairie and clay hills. The pastures are mainly confined to the bottom wooded lands and bluffs along the stream, and afford good summer and winter grazing. The equipment of live stock consists of six pure breeds of cattle, six of hogs, seven of sheep and five of horses. These animals are used in connection with the practical operation of the farm, and also in scientific experiments conducted by the experiment station. The dairy herd, for instance, is under investigation the year round and a complete record is kept of all feed consumed by each breed and charged at the prevailing market prices, and the product is credited at its actual value. In this manner the net profit from each cow in the herd is determined, and incidentally much valuable data is afforded for the study and investigation of the dairy type and characteristics and other problems of this nature. A similar investigation is in progress with the various breeds of hogs and sheep, and the results from year to year are recorded in the station bulletins, some of which have been quoted extensively on both continents, and published entire in the publications of two foreign governments, namely, Canada and Germany.

The entire farm is managed on a practical and educational basis, and the most advanced methods, appliances and machinery are introduced in all of the work. It is necessarily much more expensive to conduct a farm on this basis, with a multiplicity of breeds requiring separate quarters and care. The educational demands make heavy inroads in the financial returns, but notwithstanding these difficulties the farm is on a self-sustaining basis. Superior animals of the various breeds are furnished to farmers of this and other states for breeding purposes, and it is the policy of the department to send out nothing but stock of high excellence. Prices obtained for this stock generally range considerably lower than prices for stock of corresponding value sold elsewhere.

Much of the work in conducting the farm and investigations by the experiment station is performed by students. The price for such work ranges from 7½ to 15 cents per hour, according to the value of the service rendered. This work also has a practical and instructive value, though it is optional, to the student. The field work of the farm and station affords object lessons in good plowing, preparation of the soil, cultivation, harvesting, handling and storing grains and farm crops of all kinds, and these practices are taken up and discussed both in the field and lecture room. The management of the various herds representing the numerous breeds of live stock kept on the farm afford similar lessons in animal husbandry.

The voluntary system of labor and the object lesson method of instruction combined with scientific study and technical information has been adopted in preference to the original policy of compulsive labor. Many of the young men taking agricultural instruction at the college have served an apprenticeship on the best farms of Iowa and other states, and to require them to spend a good portion of their time in plowing, ditching, cultivating, pitching hay, stacking, and other menial work would be a manifest injustice. On the other hand, the instruction furnished comprehends a knowledge of the principles involved in doing all of this work and the most advanced scientific and practical methods employed. Though the students do not dig ditches and lay tile, they establish and run the lines, set grade stakes, and inspect and oversee all of the work. They also study the reason for drainage and character of lands requiring drainage, and the benefits to be derived therefrom. The composition and value of hay and forage plants are subjects of investigation and the students are taught to grow these crops in such manner as to give the best results. The work of the experiment station in the growth of field crops and the management and production of live stock affords many object lessons. During the past season the various breeds of hogs have been under experiment to demonstrate the relative cost of producing pork from the English bacon breeds known as the Tamworth and Yorkshire, and the Poland China, Berkshire, and Chester White, commonly known as the corn belt or lard producing hog. This investigation just now is of wide practical interest, owing to the fact that the leading markets of the world are demanding a different product, that is, a leaner pork and bacon than has been formerly furnished, and it is well known that the comparison of pork products in foreign markets is very unfavorable to the American article, and there is a consequent loss of at least 25 per cent by reason of lack of conformity to this demand. This work has been carefully taken up on an extensive scale and the animals and results are under observation and used for instruction before the classes. Similar work has also been in progress for several years past with the various breeds of sheep, including those adapted especially for wool and others for mutton production, and in addition lambs bred on the western and southern range territory.

THE CREAMERY.

C. F. CURTISS, PROFESSOR.

The college creamery is operated as an educational feature of the college, and the work is also conducted on an extensive commercial scale. The daily supply of milk received at the creamery ranges from 10,000 to 25,000 pounds. This milk is purchased from about 200 patrons and rated according to its value as determined by the Babcock test and inspection for purity, cleanliness and wholesomeness. The standard of the milk in these latter qualities has been very materially raised within the past year by a system of grading into two classes or more, and rating according to value. The milk received at the creamery is used for both butter and cheese making and in conducting the investigations in dairy work. The work of experimentation is separated financially from the commercial operation of the creamery, and the instruction given affords good practical as well as scientific training, as nearly all of the work in running the creamery and turning out superior products is done by students under the direction of skillful instructors. The students themselves are taught to receive, inspect and weigh the milk at the delivery platform, temper it for separating, manage the separators, ripen the cream by the latest and most approved methods, operate the churns and butter workers, color, salt and pack the butter ready for shipment, and note the results of its rating on the market. The same process is taken up in the manufacture of cheese, and all of the conditions favorable to the production of a first-class product are carefully studied.

This department of the college affords instruction in four distinct dairy courses, namely: a four weeks' winter course adapted especially for buttermakers who have had previous experience; a one term course, a one year course, and a four year course in dairying and agriculture. These courses of instruction, in addition to the practical and technical work required in the creamery, embrace a series of lectures covering all phases of dairy work, including instruction in mechanics and dairy machinery, and lectures on dairy stock, dairy bacteriology and dairy feeding. It is also designed to teach dairying on a smaller or farm scale as well as the management of creameries on a more extensive plan. The number of students taking dairy instruction in the different courses is about 100 per year, and the demand for competent dairymen and buttermakers exceeds the supply.

During the past year several graduates have been furnished to take charge of large city dairy establishments that are being operated by advanced methods, and pasteurized and sterilized milk of guaranteed purity and quality sold in bottles. The demand for higher skill and more thorough training has quite generally characterized dairy work within the past few years. Methods employed within the college creamery have been introduced by many of the leading and most progressive dairymen of the state, and have also attracted wide attention elsewhere. The product of the college creamery has invariably commanded a premium of ½ to 1 cent above the top quotations of New York and other eastern markets, and where it has entered into competition with other products it has universally taken high rank The dairy school has in all lines been practical as well as scientific, and demands for butter makers have come from nearly every state in the union. The students also come from almost as wide an area, although by far the larger part are confined to our own state.

The creamery is well equipped with all modern appliances and machinery, and the annual expenditure for milk amounts to from $20,000 to $25,000. The receipts from the sale of dairy products are sufficient to cover practically all of the running expenses of the creamery with the exception of the expense of instruction given to students; thus the commercial feature of the work is self-sustaining and the instruction is materially strengthened thereby. All expenditures and collections are made by the treasurer of the college, where a complete record of all transactions is kept.

THE EXPERIMENT STATION.

AGRICULTURAL SECTION.

C. F. CURTISS, DIRECTOR.

During the period covered by this biennial report quite extensive investigations have been made in the field of animal and dairy husbandry and the study of economical production of field crops. Bulletin No. 32 contains the report of an experiment in feeding cows, conducted with a view to determine the cost of producing butter from cows of different breeds on varying rations. The cows used in this investigation were representatives of the Jersey, Holstein and Shorthorn breeds taken from the college dairy herd. Extensive use was made of the several root crops usually grown for this purpose in connection with field cured corn fodder fed dry and steamed, and supplemented with a good grain ration, followed by a grazing period with and without grain This investigation covered a period of 143 days with eight cows.

Bulletin 32 also contains the results of an investigation made to determine the effect of feeding cotton seed meal to dairy cows. During the winter of 1895-96, owing to the high price of corn and other farm feeds, cotton seed meal was largely shipped into Iowa from the southern cotton belt states. It was delivered at about $17 per ton, and at this price constituted an economical and profitable feed for supplementing corn and other grain and fodder rations. It was desirable, however, to know to what extent it could be judiciously and safely fed to dairy cows and other stock without endangering their health or unfavorably influencing the quality and market value of dairy products. This work was taken up with five grade Shorthorn cows that had recently calved, and they were used through six test periods of ten days each The amount of cotton seed fed ranged from one to six pounds; and the cotton seed meal was also used for hog feeding in conjunction with the dairy. It was found that no injurious effects were apparent in the butter until the amount of cotton seed meal reached or exceeded four or five pounds per head daily. The butter in this experiment was sent to Chicago and scored by experts who had no knowledge of the conditions prevailing in the experiment, and a careful chemical analysis was also made by the station chemist.

Another article in this bulletin treats of the maturing of skim milk calves In a previous bulletin (No. 25, issued in September, 1893,) a preliminary report was made of an investigation begun in that year to determine the value of skim milk as a product for feeding calves in conjunction with the principal farm grains, and also the economy of growing such calves to maturity for the market. The report in Bulletin 32 deals with the growth and development of these calves from the termination of the milk feeding period until they were placed on the market when 26 months old. A detailed record is furnished of the cost of feeding from the beginning to the end of the investigation, and their value on the market was obtained to determine the advantage and profit resulting in marketing at different ages.

The experimental crop notes for 1895 covered the year's investigation with winter wheat. A yield of 48 to 54.7 bushels per acre was obtained from the Turkish Red variety. The press drill was again compared with the common drill and broadcast seeding. Eight varieties of oats were tested and the yield ranged from 71½ to 150 bushels per acre. The eight varieties of corn grown upon the experiment station grounds during that year showed a range in yield from 47.1 to 107 bushels per acre.

The results of different methods of restoring pasture are also reported. In this investigation one-tenth acre plots of blue grass pasture were treated with land plaster, liquid manure, and timothy and clover seed disced in and the crop compared with a plat having no treatment. The application of liquid manure and the discing of clover and timothy gave decidedly beneficial results, and we have tried this treatment with larger areas during the past season with equally marked improvement.

An extensive investigation in the production of butter flavors is also reported in Bulletin 32, in which it is shown that the flavor of butter under normal conditions with good milk is largely controlled by the methods employed in ripening the cream. This is an advance that recent improvements in butter making have developed, entirely contrary to original ideas concerning this subject, as it was formerly supposed that the cow and her feed, and breed characteristics, were the most important factors. Under the light of recent investigation the intelligence of modern butter making has largely supplanted these. The methods employed in this experiment and applied in our creamery have since become largely adopted in the leading creameries in this and other states, and the college has supplied butter makers to some of the largest firms of the country for the introduction of these principles.

The article on soil moisture in this bulletin presents a report of joint work of Dr. Weems and the agricultural section, and work has been conducted since 1895 under the supervision of Mr. Edgerton in conjunction with the chemical section. Some interesting data has been obtained of practical value in successful cultivation and crop production. These later results are now being prepared for publication in forthcoming bulletins.

Under the title of "Our Window Gardens," Mr. George W. Carver, professor of agriculture in the Tuskegee college of Alabama, who was at that time employed as assistant in the experiment station, while doing post graduate work, furnishes a practical contribution on the propagation and management of house plants.

In the winter of 1895–96 the station took up the investigation of mutton and wool production, with a view to furnishing as much exhaustive and practical information on this subject as possible. The sheep industry was at that time in a very depressed condition, and there seemed to be a lack of essential information concerning this branch of live stock. In order to cover this field as fully as possible, carefully selected representatives of ten of the leading breeds of sheep were obtained and put into a ninety-day feeding test. The breeds represented were Southdowns, Shropshire, Oxford, Suffolk, Lincoln, Leicester, Cotswold, Dorset, Merino, Range, and Shropshire-Merino cross. A careful record was kept of all the details of the feeding work, and at the end of the test the gain and cost of production were computed, together with many other items of interest, including the weight and value of wool, and the different lots were placed upon the market and sold on their merits, and a careful slaughter and block test conducted by Swift & Company. All of these lots representing the different breeds, and cuts of mutton from each were illustrated in Bulletin 33; and Bulletin 35, lately issued, contains an extended account of a second investigation of this character and a summary of results in both experiments. It is the policy of the station to duplicate most of its important investigations in order to verify results and insure greater accuracy. This experiment has met with a grateful appreciation by sheep men generally, and it has been widely quoted and republished in full in the publications of two foreign governments; namely, the Canadian and the German Agricultural societies. Bulletin 33 also contains the second investigation in comparing the feeding value and relative merits of steers, spayed heifers, and open heifers for beef, and in this investigation, as in the first, the heifers have made a decidedly favorable showing. The second experiment was more satisfactory than the first in many respects. It was also found that the discrimination against heifers in market had largely diminished. In the first experiment a distinction of $1 per hundred was made; in the second, a difference of only 25 cents per hundred weight was made, and in the slaughter and block tests that were conducted both lots of heifers showed a higher percentage of beef than the steers, and the entire car load made a record of 67½ per cent, which has never before been equaled by any car load of cattle slaughtered in Chicago. These cattle were finished at two years of age and illustrations, and photographs of the meat reproduced in the bulletin.

A comparison of the feeding value and chemical analysis of new and old process oil meal is also reported in Bulletin 33; and this bulletin contains a report of the first experiment conducted at the creamery in comparing the milk of fresh and stripper cows for butter making. It is well known that there is an old established theory to the effect that good flavored butter can not be made from the milk of stripper cows. In previous investigations conducted at the station in dairy work it was found that the method of ripening cream for butter making had much more to do with the quality of the product than the character of the cow or feed, provided they were in normal condition. The college herd was divided into two sections; the fresh cows being placed in one group and the strippers in another, and the milk carefully ripened and butter made from each lot and sent to experts in Chicago for scoring with the result that there was no appreciable difference; and by the application of advanced methods the flavor was controlled by the butter maker independent of advance in the cow's period of lactation. This investigation has since been repeated and uniform results obtained in three distinct experiments.

Bulletin 35 contains the report of a continuation of the lamb feeding experiments already referred to taken up the winter of 1895-96 and a summary of results of both investigations. In addition to this work in feeding lambs, an experiment with 252 head of range lambs representing three distinct lines of breeding, and one lot shorn compared with the unshorn is reported. These lambs were fed primarily with a view of determining the economy of mutton production with that class of stock and thereby affording a market for the surplus product of cheap grain in this and other states similarly situated during the past winter. The experiment was of very general interest and the results are quite satisfactory and of practical value to a large class of feeders.

In Bulletin 35 a third experiment in raising calves on separator milk is reported. This experiment was conducted along similar lines to those reported in previous bulletins and the results of the three experiments are summarized and shown to be entirely consistent in establishing a superiority of the carb hydrates and fat-containing feeds, such as cornmeal, oats, and flax seed, over the nitrogenous by products like oil meal, in supplementing a skim milk ration for calves. Another feature of practical interest in this investigation is that the carb-hydrate feeds represented by corn and other grains are much more abundant and economical. This experiment was conducted with a carload of calves that are being carried on to maturity under experimental conditions.

Another article in Bulletin 35 presents a continuation of the work in ripening cream by the methods previously described.

SUGAR BEETS.

The prospective sugar beet industry of Iowa has attracted considerable attention and its significance to the agriculture, manufacturing and commercial interests of the state fully warrant this consideration. Within comparatively a few years sugar has assumed a prominent place in the daily bill of fare in all civilized nations and it is no longer regarded as a mere luxury in the form of a condiment or sweetening for other foods; but recent investigations in testing the endurance of European armies on various foods have developed the fact that sugar is an important nutrient and well calculated to repair the waste tissues of the body and sustain physical and mental exertion. It is not strange, then, that the consumption of sugar by the American people should have reached over sixty pounds per capita annually, and the world's consumption of sugar increased over two-thirds within a decade. We consume more than twice as much sugar per capita as the German people, notwithstanding the fact that Germany leads all the nations in its production for export. So important is this industry regarded there, that a tax is put on sugar consumed at home and a bounty paid on that exported.

The people of Iowa annually pay out about $6,000,000 for sugar. Perhaps it does not often occur to us that this expenditure amounts to about $16,000 a day by the people of an agricultural state for a product that is purely agricultural in its primary form and for the production of which all other conditions are favorable.

An acre of good Iowa land planted to corn, yielding forty bushels and marketed at 20 cents per bushel will buy about 150 pounds of pure granulated sugar. The same area planted to good sugar beets and properly cultivated will easily yield 2,500 to 3,000 pounds of pure sugar. There is, of course, a larger outlay and expenditure in growing the beets, and the expense of manufacturing is also involved in the production of the sugar, but the cash return from an acre of corn on the foregoing basis is only $8, while the cash return to the farmer from a good crop of sugar beets is $45 or $50 per acre. In the adjustment of our international accounts it required every pound of the wheat and flour we exported last year to pay for the sugar imported. This amount reached $100,000,000; or more money than we pay for any other article from foreign countries; and notwithstanding the magnitude of our meat producing industry, it required all of our export beef, beef products and lard last year to pay for the sugar we ate.

These considerations, together with the fact that Iowa lies wholly within the sugar belt as described by the lines of favorable climatic and soil conditions for sugar production, have led to quite extensive investigation of this subject by the Iowa Experiment station. This investigation began in 1891 and has been continued every season since, though the largest areas have been grown in 1891 and 1897. It was the opinion of those in charge of the station then, as now, that this industry would eventually be developed in America, and the object has been to accumulate as much practicable and valuable data and other information as the subject warranted. A very general interest has been manifested in sugar beet growing during the past season. Through the co-operation and assistance of the United States Department of Agriculture the Iowa station has distributed over 1,500 pounds of seed. The requests for this seed have come from every county of the state. Instructions for preparing the soil, planting and growing the crop, and forwarding samples for analysis, have been sent with each package of seed, and nearly a thousand samples of beets have been analyzed in our chemical laboratory under the direction of Dr. J. B. Weems, the station chemist. These results are of interest in establishing the general adaptation of our soil and climatic conditions for sugar production, and they fully confirm Iowa's possibilities in that line, although the beets grown have not all been up to the standard required for practical sugar making. This deficiency, however, may be fairly attributed to a lack of knowledge and observance of the required systematic and careful methods by the grower, rather than the absence of naturally favorable conditions. That this conclusion is warranted is demonstrated by the fact that nearly every county in the state that has forwarded beets for analysis has furnished both high and low grade samples. The following tabulated results of analyses of beets grown in several counties in various sections of the state, giving the average results of all samples in sugar and purity, and maximum and minimum results, and the average results of the poorer and better samples grouped in two divisions, will quite clearly present this variation.

COUNTY.	Total No. of samples analyzed.	AV RESULTS OF ALL SAMPLES ANALYZED.		MAXIMUM AND MINIMUM PERCENTAGES FOUND IN SAMPLES.				AVERAGE RESULTS OF POOREST SAMPLES.			AVERAGE RESULTS OF BEST SAMPLES.		
		PERCENTAGE		MAXIMUM PERCENTAGE.		MINIMUM PERCENTAGE.		Number of samples.	PERCENTAGE.		Number of samples	PERCENTAGE.	
		Sugar.	Purity.	Sugar.	Purity.	Sugar.	Purity.		Sugar.	Purity.		Sugar.	Purity.
Adair	6	13.41	77.45	15.78	84.33	11.30	69.57	2	11.39	71.38	4	14.41	80.40
Allamakee	15	14.26	79.47	17.10	84.74	8.08	69.00	3	11.06	76.99	12	15.06	80.09
Black Hawk	9	13.92	79.86	17.20	94.64	11.30	71.62	2	11.55	72.60	7	14.60	81.94
Boone	21	13.33	76.81	19.06	86.38	10.93	72.34	8	11.82	72.68	13	14.26	79.36
Buena Vista	7	13.63	77.70	15.52	82.60	11.30	74.12	2	11.80	74.23	5	14.36	79.07
Calhoun	8	15.80	81.46	16.18	81.14	13.09	73.80	1	13.09	73.80	7	16.53	82.47
Carroll	9	12.28	75.51	14.13	79.60	10.22	63.43	6	11.49	74.10	3	13.85	78.33
Cass	14	11.87	74.68	16.72	86.40	9.09	65.43	8	10.25	70.16	6	14.30	81.48
Clayton	6	13.48	78.47	16.00	85.98	11.21	72.97	3	12.08	74.06	4	14.89	82.87
Fayette	6	14.92	80.25	17.92	88.84	11.33	70.12	1	11.38	70.12	5	15.26	82.37
Greene	34	12.99	77.81	15.69	84.28	8.65	62.29	18	11.69	74.45	16	14.45	82.19
Hamilton	10	12.58	75.34	15.07	81.56	10.28	65.85	7	11.84	73.46	3	14.28	79.75
Humboldt	11	14.29	80.09	18.76	86.28	10.81	70.53	5	12.09	76.95	6	16.12	83.79
Johnson	9	12.58	75.59	14.79	77.23	9.83	67.54	5	11.65	71.94	4	13.74	80.15
Marion	28	12.74	74.06	16.51	80.64	5.69	47.88	19	11.61	71.32	9	15.12	79.80
Marshall	11	12.51	74.88	16.03	82.57	8.97	62.56	7	11.46	71.55	4	14.34	80.56
Mitchell	10	12.37	76.21	14.16	82.28	10.76	71.39	7	11.80	71.80	2	14.38	81.18
Pottawattamie	25	13.00	77.98	16.34	85.83	10.43	74.74	18	12.23	76.58	7	14.83	81.58
Story	19	12.19	76.32	15.02	82.82	10.15	75.26	15	11.66	77.22	4	14.23	79.93
Washington	5	12.84	77.86	13.59	82.38	12.72	74.68	1	12.72	74.68	4	14.12	78.65
Woodbury	8	12.68	74.10	14.49	80.09	11.35	68.16	6	12.14	72.29	2	14.31	79.53
Benton	7	13.45	76.68	14.94	77.17	12.54	72.65	1	12.54	72.65	6	13.61	77.30
Cedar	9	12.56	74.48	15.13	79.03	10.97	70.17	4	11.41	[illegible]	5	13.47	76.28
Chickasaw	7	13.84	75.54	14.31	78.66	11.96	68.68	3	12.56	73.67	4	13.93	77.69
Clinton	4	15.81	78.97	18.11	81.83	11.41	74.09	1	11.41	74.09	3	17.28	80.60
Decatur	4	14.15	79.27	18.98	77.87	12.22	78.08	0	...	.	4	14.14	79.27
Delaware	5	13.23	75.56	16.43	80.99	11.03	71.27	2	11.40	71.19	3	14.44	18.82
Floyd	10	12.77	75.01	15.56	82.19	7.98	67.28	6	11.54	73.98	4	14.62	75.56
Grundy	9	12.00	73.91	14.53	81.76	9.20	63.76	5	10.67	70.07	4	13.67	78.71
Hancock	18	11.90	75.82	15.90	79.06	7.78	69.94	14	10.22	69.12	5	14.17	79.41
Hardin	7	12.88	77.03	15.18	80.41	11.08	71.36	5	12.33	76.21	2	14.26	78.96
Jasper	14	13.06	76.88	16.62	77.29	9.22	65.56	8	11.97	75.92	6	14.53	77.95
Kossuth	6	12.58	77.26	15.38	83.58	8.54	66.20	3	10.80	71.28	3	14.35	83.23
Linn	6	12.08	74.02	16.83	83.49	9.33	69.94	5	11.14	73.73	1	16.73	83.49
Madison	7	12.55	74.34	14.31	79.77	9.58	60.61	5	11.89	71.67	2	14.21	81.03

The foregoing results, though incomplete, are fairly representative of the sugar beets grown in the state during the past season. The figures contained in the last three columns under the head of "average results of best samples" indicate quite satisfactory beets, although in a few cases the purity is below the required standard. For commercial sugar making a beet is required containing not less than 12 per cent pure sugar with a purity co-efficient of at least 80 per cent. Sugar beets containing more impurity than this are unsatisfactory for manufacturing, for the reason that each additional pound of impurity or foreign matter in the beet juice keeps at least one pound of sugar from crystalizing. Sugar beets that are carelessly grown are more likely to be deficient in purity than in sugar, likewise immature beets and those grown on rich soil containing an excess of barnyard manure or vegetable matter generally carry considerable solid matter in the juice which is not sugar, and consequently their value is impaired for sugar making purposes. For this reason swamp land or newly cleared forest land is unsuited to beet growing. Large beets are also almost invariably poor in sugar and purity. Many of the beets analyzed at the experiment station this year were forwarded early in the season before the crop had fully matured, and as a result the analyses did not indicate as good beets as the conditions were capable of producing. A good many of the low percentages of both purity and sugar in the foregoing table are due to premature gathering of the beets.

The influence of this factor is shown in the following results of 139 samples of beets from twelve counties and tabulated according to date of harvesting:

18 samples Sept, 15 to Oct. 5, average per cent sugar 11 52; average per cent purity 72 88
62 samples Oct. 5 to Oct. 25, average per cent sugar 13.12 average per cent purity 76.82
59 samples Oct. 25 to Nov. 15, average per cent sugar 14.05; average per cent purity 80.13

It is probable that the results were more largely governed by the date of harvesting during the past season than usual, but these figures indicate the importance of having the crop fully matured. For that reason it is always best to plant the seed as early in the spring as soil and temperature conditions will warrant. At the experiment station we have made it a rule to plant sugar beets immediately after corn planting. A good stand is absolutely essential to success, and all conditions at time of planting must be as favorable as can possibly be obtained. An uneven stand results in large beets adjoining the vacant places, and these beets, as previously explained, are always comparatively low in sugar and purity.

"The sugar beets grown on the experiment station grounds have always ranked higher in both richness and purity than those grown in other sections of the state. This superiority has doubtless been largely due to the exercise of more care in preparing the ground and cultivating and growing the crop. The accompanying photograph of the field of beets grown during the past season indicates the condition of the crop during the month of August after cultivation was finished.

"Six varieties of beets were grown during the past season and each variety on six different plots under varying conditions. The average results were as follows:

VARIETY.	Sugar, per cent.	Purity, per cent
Schreiber	15.09	83 23
Original Klein Wanzleben	14.72	82.63
Eramez Elite	14 30	81.60
Zieman	13.90	79 72
Dippe	13.83	78.81
Vilmorin	13.32	80.11

"All of these varieties with two exceptions have been above the standard in quality and purity. The varying conditions of soil and cultivation which constitute a part of our experiments in growing these beets were not all favorable to the best results, and this feature has tended to somewhat reduce the average. This has always been the case, in previous experiments as well, but all of the beets that have been grown carefully with a view to securing the best results have always measured up to a high enough standard to be fully satisfactory for commercial purposes. The average yield on fourteen plats that were fairly representative of the entire area was twenty-two tons per acre. The past season was quite unfavorable for germination, owing to the low temperature at planting time. This prevented an even stand, and to some extent affected the quality of the crop. All crops were backward throughout the season and did not ripen at the usual time, although the autumn was mild and continued favorable until a late date. The station plats were sampled for analysis twice during the harvesting period; the first on October 23d and the second November 11th. The results were as follows:

Sixty-four plats October 23, average per cent sugar, 13.29; average per cent purity, 79 43
Same plats November 11, average per cent sugar, 14.19; average per cent purity, 81.47

"These results confirm the conclusion that immature beets are always of poorer quality than those that have properly ripened. In some cases, however, it has been observed that beets are injured by being left in the ground too long. When the season is favorable for early ripening and late fall rains causing new growth to set in the beets rapidly deteriorate in quality. This is a matter that requires close observation and the exercise of good judgment.

"When sugar beet culture was first considered in the West it was thought that sandy soils were necessary to the successful growth of the crop. It has been determined, however, that this is not essential. A wide variety of soils have been tested on the college farm and at various points in the state and also in other states, and the general conclusion is that any fairly good soil that will grow a satisfactory crop of corn or potatoes will produce sugar beets successfully. Soils containing an excess of vegetable matter, as already explained, are objectionable, and on the other hand a depleted soil is not suited to beet growing. It is also well established that the good soils of this state do not require fertilizing for sugar beets. Various fertilizers have been tried without resulting in any appreciable improvement of the crop. It is generally believed by those who have been most successful in growing test patches throughout the state that sugar beets can be profitably grown for $4 per ton, the usual price prevailing where factories are in operation.

"It has been difficult to determine the actual cost of the crop at the experiment station on account of the features of investigation involved, but we have produced satisfactory crops at a cost not exceeding $2 per ton for the labor and seed, making no allowance for rent of the land. The large amount of hand labor—hoeing and weeding, considered necessary in producing sugar beets has been deemed a formidable difficulty in the way of growing the crop commercially or on an extensive scale. This is largely obviated by the use of improved machinery and the application of proper methods in preparing the seed bed and cultivating thoroughly at the right season, though the thinning, and at least one weeding must be done by hand. This cannot be obviated but can be done with cheap labor. The use of improved machinery also greatly facilitates the work. We have on the college farm a seeder that plants and covers four rows at a time and will readily plant as many acres a day as can be planted to corn with an ordinary corn planter; and we also have a cultivator adapted to cultivating four rows at a time. There is no question about doing the work. Iowa farmers will produce the beets if it will pay.

"There are good and essential reasons why the beet sugar industry should be established in Iowa. In addition to saving the expenditure of $6,000,000 annually that should be kept at home, it would bring a better system of agriculture to the state in all of its branches. Sugar beet culture would bring more thoroughness, more careful methods, more intelligence, and a more rational and better balanced system of farming. Every well cultivated field of sugar beets stands as an object lesson in good farming and a protest against superficial and slovenly methods. Sugar beet growing necessitates the intensive system of agriculture, and this system applied to Iowa means better crops, better stock, better farm products, better homes, and a better farm life in every way. The introduction of beet culture would be of incalculable value to the live stock industry, independent of its other advantages. The beet pulp and the roots that would be fed directly to stock would result in higher excellence and greater economy of production. Then, too, there is no crop that could be so advantageously introduced in our plan of rotation as the sugar beet. It is eminently adapted to combining with the grain crops. Chemically considered, pure sugar consists of nothing but carbonic acid gas and water, both of which nature has supplied in great abundance. The removal of a crop of sugar takes nothing from the soil that is of any value in fertility. If the pulp is fed and the droppings of the animals applied as manure, beets will exhaust our lands less than any crop we can grow. There are only three agricultural products that can be grown extensively without exhausting the soil, viz: sugar, cotton and butter. When we sell butter we sell a pure fat, and $1,000 worth of it would not contain 50 cents' worth of material that has any fertilizing value, and if we were to sell sugar we would be selling pure carbhydrates that have no value as fertilizer. But $1,000 worth of wheat or oats at present prices would take from the land over $300 worth of fertility, or at least that which would cost that amount if restored in the form of commercial fertilizers. Commercial fertilizers will never become necessary in Iowa provided rational policies are pursued, but it will be profitable to conserve fertility by every reasonable and judicious method.

"The results of the experimental work in sugar beet growing in Iowa have fully confirmed the opinion that sugar making in the state is practicable, and there is every reason to believe that the work might be profitably carried on. This is gratifying to those interested in the welfare of the state, but on the other hand there is nothing in these results to fully warrant or encourage the establishment of factories under present conditions. Favorable soil, climate, and all natural advantages, such as cheap coal, good transportation facilities, an ample supply of water of good quality and rich deposits of unusually pure limestone are present in great abundance; but evidence is yet lacking that any locality in the state has made such progress and attained such results in successful sugar beet growing as to be particularly encouraging to the investment of sufficient capital for the erection of a factory. This statement may seem a little inconsistent, but when it is remembered that every beet sugar factory that is in successful operation in the United States to-day has been obliged to undergo a severe struggle and operate at great disadvantage during the first years of its existence, while farmers were learning to grow beets successfully for practical sugar making, the erection and operation of a $400,000 or $500,000 plant several years in advance of the conditions essential to practical success from a business standpoint is not inviting, and it is only natural that capital should seek localities that afford the best opportunities. The latest advice from the secretary of agriculture is that there is reason to believe that at least a score of new factories will be erected in the sugar beet belt of the United States in time for the next crop, and that as a means of demonstrating the advantages of certain localities, particularly with reference to growing the beets successfully by the farmers, experts are being employed to superintend the cultivation of large areas, with a view to making the strongest showing possible. The matter of uniform good results is of vital importance in sugar beet production from a commercial standpoint. Iowa results seriously lack that uniformity, as will be observed from an examination of the accompanying records. It is altogether natural that this should be so. The methods of successful beet culture are an innovation in Iowa agriculture. It requires years of careful study and experience to attain the required results. When the first sugar beet factories were established, both in the United States and Europe, the best beets that could be grown averaged only 6 per cent sugar. The application of skill and intelligent methods has brought the beet up to its present high standard of 12 to 18 per cent, and the same care and thoroughness are necessary to sustain and advance this standard.

"It has been suggested that the Iowa experiment station take up the work of giving extensive instruction in sugar beet growing in various sections of the state, when called upon to do so, in order that the beets grown may be brought to a higher standard, and thereby be made more encouraging to the investment of capital in the establishment of factories. This course would undoubtedly lead to results of very much greater value than any work that has yet been done. The only way by which this work could be taken up practically and satisfactorily, however, would be by putting skilled men in the field at different places in the state, to remain on the ground as long as necessary to properly superintend every operation in producing the crop. It is to be regretted that the present condition of the station funds will not permit of the adoption of this plan, however beneficial or desirable it may be. The station already has extensive work in progress in the various lines of practical agriculture, and the demand for its publications has increased so much of late that the additional expense involved makes it impossible to publish all of the results of the past year's sugar beet investigation in detail.

"The magnitude and importance of this subject and its vital bearing on all the material interests of the state call for such action as will put the resources of the state in the most favorable light."

ENTOMOLOGICAL SECTION.

HERBERT OSBORN, ENTOMOLOGIST; ELMER D. BALL, ASSISTANT.

Work in the entomological section has followed lines laid out in previous years, and a principal subject of investigation during the biennial period has been the insects affecting grasses, especially those minute but enormously abundant forms included in the family *Jassidæ.* The importance of these insects is but partially appreciated, owing to their smallness and the fact that their insidious work, while a constant drain on pastures and meadows, is seldom of a character to attract the attention of the casual observer. A considerable contribution on the life histories of these, including some species that are injurious to garden crops and to orchard trees, and which may be considered a continuation of the paper in Bulletin No. 34, is presented herewith.

The correspondence relating to injurious insects has been quite extensive and embraces a great variety of species.

Many farmers were apprehensive of a recurrence of the outbreak of the army worm, which caused considerable loss in 1896, but from the past history of the insect I felt warranted in predicting that there would be little, if any, trouble this season. The outcome of the season supports the past history for the species, and it may be considered as very exceptional if a year of great army worm depredation should be followed by a second of the same nature.

Early in spring numerous specimens of the apple plant louse were received from widely different parts of the state, and usually the twigs accompanying the specimens were found to be thickly set with the eggs of the insect. Considerable injury resulted, and doubtless the apple crop was somewhat affected by the sapping of the blossom buds; but the injury did not continue beyond the first few weeks of the season.

Later in the season plum trees were seriously attacked by plant lice, and very extended injuries resulted, in some places the plum crop being materially affected. The use of kerosene emulsion, where promptly applied with suitable apparatus, gave good results, but considerable complaint of inefficiency of this measure was heard, and in order that the best results be secured it is necessary to insist on thorough work with an apparatus capable of driving a fine mist to all parts of the infested leaves.

The outbreak of the Hessian fly noted for the northwestern part of the state has been watched during the past season, but in most of the localities has been less serious than in 1896. In many fields there was a certain amount of injury, a small proportion of the wheat falling down from the attacks of the insect, but in most cases this was so slight as to attract but little attention. The matter is of importance, however, as a slight increase would result in a marked reduction of the crop.

Owing to the extreme danger of the appearance of the San Jose scale in the state we have naturally given close attention to this pest. While no occurrences have as yet been detected in the state, there is of course the probability that it has gained a foothold in some quarter, but without as yet attracting such attention as to bring it to our notice. Early in the season a press report was distributed and published in the papers of the state, calling attention to the dangers of introduction, and in Bulletin No. 36 an illustrated article is included so that it is hoped any possible occurrence may be immediately recognized.

No effort should be spared to prevent, if possible, the introduction of this formidable pest, or the prompt extermination of it in any locality where it may gain a chance foothold. It is known to winter well in Minnesota and to be a most serious pest in many of the northern states, so we must look upon it as a menace to the fruit industry of the state.

LIFE HISTORIES OF LEAF HOPPERS (JASSIDÆ.)

SPECIES AFFECTING GARDEN CROPS.

The Agallia.—The members of this genus are all small, compact little leaf hoppers from one-fourth to one-eighth of an inch in length, with short, transverse head, and stout bodies entirely concealed by the thick elytra. In color they are either grayish or slaty, according to the species. There are usually two round black spots on the head between the eyes, and in most of the species another pair on the pronotum, together with various other dark markings The different members of the genus are widely distributed throughout the world, the greater number of species, however, occurring in North and South America.

The species are very difficult of separation and little has been published in regard to their food habits or life histories. During the past season the three following species have been under observation and their larvæ and the general facts of their life histories determined. In order to correctly determine the species under observation, as well as those sent in from other states for determination, a systematic study of the genus was undertaken, the complete results of which will be published elsewhere.* The genus was found to be separable into three groups, of which the three species treated are typical illustrations as far as structural characteristics of the adults are concerned, and the known facts in regard to the larvæ and life histories of the other species indicate that they too will be found to be very similar within the groups. In general the species were found to be widely and generally distributed and subject to little variation except in depth of color. The three species treated, though by no means limited to that area, are all that are now known to occur in the northern and eastern part of the United States, while in the southern states *constricta* replaces *4 punctata* and extends along the Atlantic coast to New York, but it is in the southwestern states and down into Central America that the majority of the species occur. The species are all single brooded, in northern latitudes, at least, and the larvæ agree in feeding on stems near the ground and hiding under rubbish.

A. punctata Prov. (Plate I, Fig. 1).—This is the broadest one of the three species, being only a little more than twice longer than wide. In color it is an obscure yellowish brown, shading to smoky on the elytra, with two large round black spots on the head between the eyes and another pair near the hind margin of the pronotum. Length, one-sixth inch (4 mm.)

The larvæ are short, stout, reddish brown forms very unlike the adult in appearance, so much so that they have been mistaken for adults of another family and so described; the head is flat and bears two "horns," thin, flat processes extending forward between the eyes; the thorax is broad and flat while the abdomen is compressed and armed on top with a deeply notched crest, the body is covered with small hair bearing tubercles, and to these adhere small particles of matter adapting it to its surroundings.

The eggs are rather large for the size of the adult, being one mm. long, slender, slightly curved their whole length, round at one end, tapering to a slightly flattened acute point at the other.

Life history: The adults appear early in the spring and may be found feeding on the different food plants until late in June. They were the most abundant about the middle of May, and frequent examination showed that the eggs are not deposited until late in the month or early in June. The larvæ appear in July, and develop slowly throughout the fall, becoming nearly full grown to pass the winter and issue as adults in the spring again.

Its natural habitat seems to be in shady woods, where the larvæ conceal themselves in the dead leaves, etc., and feed near the base of the stems of a number of species of compositæ, cruciferæ che nipodiacæ, etc., but its economic importance comes from the fact that it finds in horseradish, cabbage, spinach, sugar beets, and other garden vegetables the shady conditions essential, and it was on horseradish and sugar beets that the larvæ were found in the greatest abundance, and from which most of the observations were made.

Remedies: Where these insects become numerous upon a cultivated plant the most effectual treatment known at present is the kerosene emulsion spray, and to be most effectual it should reach the protected larvæ at the base of the leaves.

Agallia novella Say (Plate I, Fig. 2).—This species is about the same length as the preceding, but much narrower, the general form being wedge-shaped, narrowest behind, color reddish or slaty gray, with two spots on the head, as in *4 punctata*, two more on the pronotum, placed much further forward than in that species, nearer the middle than the back margin; in addition to these, there are two small spots just within and behind the eye, and a narrow light line along the middle of the elytra. Length, one-sixth inch (4 mm.)

The larvæ are smaller, but very similar in form and color to those of *4 punctata*, except for the shape of the head, which is entirely different; the head has a sharp upper margin projecting upward between the eyes; this projection is slightly cut in the middle, forming two saucer-like lobes; they are more active than those of the preceding species, and can spring several feet when the plant is disturbed, making them more difficult of capture or observation. They occurred at the same time and on the same plants as those of *4 punctata*, and the only difference noted was that the males were as common as the females, while in the latter species the males are apparently very rare

Agallia sanguinolenta Prov. (Plate I, Fig. 3).—This species is very different in appearance from the two preceding, being much flatter and more compact, the elytra are variousiy ornamented and the veins dark and distinct, while in the former two the elytra were unicolorous and the veins light. The head is proportionately longer, with two large spots, the pronotum may be entirely grayish or with dark markings, but not in the shape of two round spots; the elytra vary much in color, being often nearly transparent, with only the veins dark, but in the darker forms there is a dark saddle with a light center. Length one-eighth inch. The larvæ are very plump, active little forms, whitish, with two dark spots on the head, a number of lines on the thorax and a black ring around each segment of the abdomen.

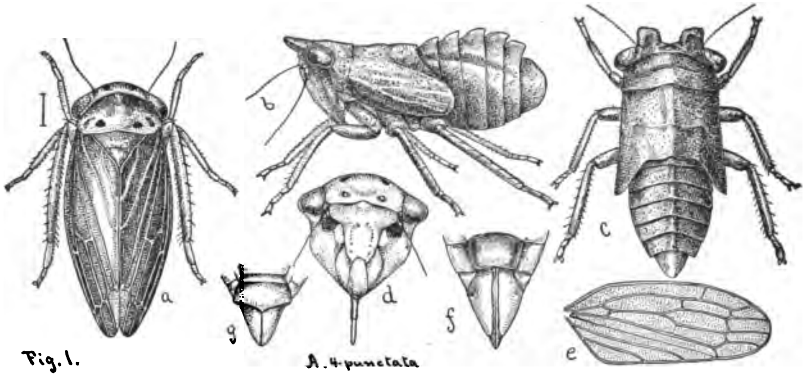


Fig. 1.

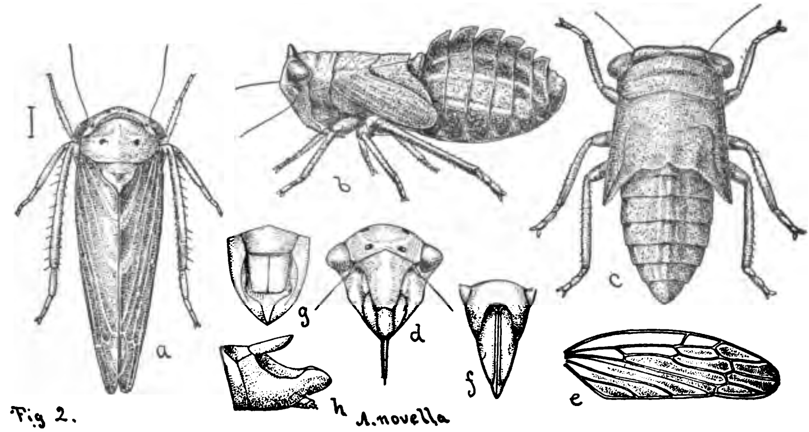


Fig 2.

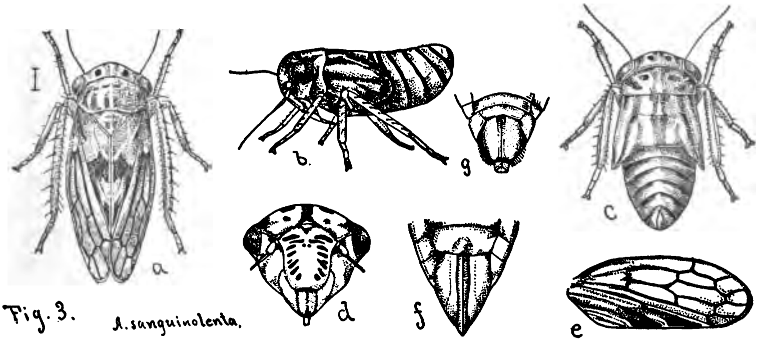


Fig. 3. A. sanguinolenta.

PLATE I.

This species prefers open, sunny locations, and occurs in great abundance in almost every conceivable situation except damp and shady woods. The adults deposit eggs early in the spring, from which the larvæ appear toward the latter part of May, the earlier ones becoming full grown by the end of June, while the majority continue well into July and some as late as August; the adults may be found from the first of July on through the season, hibernating over winter to deposit eggs in the spring again. From the early appearance of the larvæ it may be that some of the eggs are deposited in the fall, and if such is the case those females probably die, as every female examined in early spring contained eggs.

In cultivated areas they feed largely upon clovers, especially white clover, doubtless because it is not so rank a grower and does not shade them; they also feed on a large number of weeds and garden crops, and have been noted particularly on sugar beets.

SPECIES AFFECTING ORCHARD AND SHADE TREES.

Macropsis apicatis O. & B. (Plate II, Fig. 1).—This is a bright pea green species, nearly one-fifth of an inch (5 mm.) long and something less than half that wide; the head is very short and rounding, scarcely longer on the middle than at the eyes; the pronotum is large and strong with numerous fine transverse wrinkles; the elytra are strong slightly leathery, longer than the body, with somewhat irregular, raised veins and the surface covered with fine white hairs.

The eggs are white, nearly one millimeter long, and one-third millimeter wide, slightly spear shaped, one side nearly straight, the other swollen near the head and cut off obliquely at the smaller end. The eggs destined to pass the winter are deposited just beneath the epidermis of the smaller twigs, and almost invariably in a transverse position, sometimes obliquely, and often from two to four or five in a series side by side. Evidently a check or slight rupture of the epidermis furnished the point of entrance for the ovipositor, as eggs are almost invariably adjacent to such a check and at right angles to it, and a slight elevation or swelling is the only surface indication of the presence of the eggs.

They may be so plentiful as to give a rough appearance to the bark in places, and while not apparently producing distortion of the twigs, probably because they are placed so close to the surface as not to affect the growing tissue, the fact that many of the twigs affected are deadened at the tip would indicate possible injury in this manner. The eggs occur mainly on the under surface of the twig, but whether this posititon is to give the egg more uniform conditions by protecting it from direct sunlight or to the avoidance of strong light by the adult, or some other reason, is a matter of conjecture. The deposition of the summer eggs has not been observed, but it doubtless coincides with that for the winter brood.

The larvæ are stout and short, similar in color and shape to the adult, but entirely covered with coarse bristle-like hairs, rendering it easily recognizable. Larvæ and adults were found in abundance on the new growth at the end of the twigs of Honey Locust, towards the end of June, occurring in hundreds on a single tree, and although isolated trees, trees in hedgerows, and those in the native timber were examined, as well as others in different parts of the state, none were found entirely free from this insect. The larvæ had all issued by the last of the month, the adults remaining abundant until towards the end of

July, another brood of adults appearing later in September and on into October, and the eggs were deposited late in the fall, being found in the twigs during November. The larvæ and adults seem strictly confined to the one host plant, being found on the young stems and in the axils of the smaller twigs. Where these occur on shade trees of special value they could easily be destroyed by the use of kerosene emulsion in early summer.

Bythoscopus distinctus V. D. (Plate II, Fig. 2).—General form similar to the preceding, about one-third smaller, head green, reduced to a curved line bordering the rounding pronotum, narrower than the dark brown eyes. Pronotum greenish, coarsely pitted with black, darker behind eyes; scutellum triangular, green, with the corners black; wings with a broad band at base, the tip and a narrow band before it, black. In light specimens the whole wing is of a grayish slate, except for a black spot in the place of the middle band.

Larvæ stout green forms with thicker, blunter heads than the adults, nearly straight margined, with a few long hairs projecting forward; body large, plump, abdomen ridged above, the sides with a flap-like margin which fits around the sides of the leaf stem or twig on which the insect rests.

This species occurs in abundance on black walnut and butternut and adults have been found on hickory and hackberry, but only where they were adjacent to the first named trees. Full grown larvæ and freshly issued adults were found the second week in June; a few days later the larvæ had all issued, the adults remaining abundant until into July. The second brood of larvæ appeared before the middle of August, the adults again in the latter part of September, to hibernate and deposit eggs in the spring.

Genus Pediopsis.—The members of this genus are all very similar in form and appearance, though widely different in color. Though closely related to the two preceding genera, they may be distinguished by the fact that the lines on the pronotum all run towards the tip of the head, while in the former two they run across. The species all agree in being tree-feeders, both as larvæ and adults, and as far as known are all single brooded, the time of appearance varying somewhat, but all agreeing in passing the winter in the egg stage. The genus as a whole is widely distributed throughout the temperate regions of the world, and each species usually confined to a single kind of tree or to those closely related. Though strongly and variously colored they invariably mimic the part of the tree upon which they occur, the larvæ and adult often being differently colored and frequenting different parts of the same tree.

Pediopsis tristis, V. D. (Plate II, Fig. 3).—This is a large, narrow, grayish-brown species from one-fifth to one-fourth of an inch long (5–6 mm). The head from above appears only as a narrow line from the eyes around the angular point of the pronotum. The pronotum has a narrow light margin behind and is covered with fine light hairs. The wings are slightly transparent, setting off the dark margined raised veins, easily recognized by the face below, being light greenish with a large black spot in the middle below the eyes and a band on the margin above.

The larvæ are very similar in form to those of *B. distinctus*, but the abdomen is not as strongly ridged, and the head is broader. They are reddish-brown above, marked with whitish on some of the sutures, and with four dark margined light spots in the form of a square on the body. The whole surface is covered with fine white hairs, giving a light reflection. The face is light with a large black spot as in the adult. The species seems to be strictly confined to plum trees, to which it is admirably adapted in color. They were

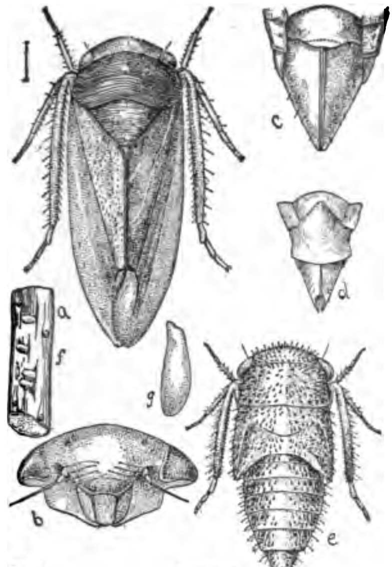


Fig. 1. M. apicalis

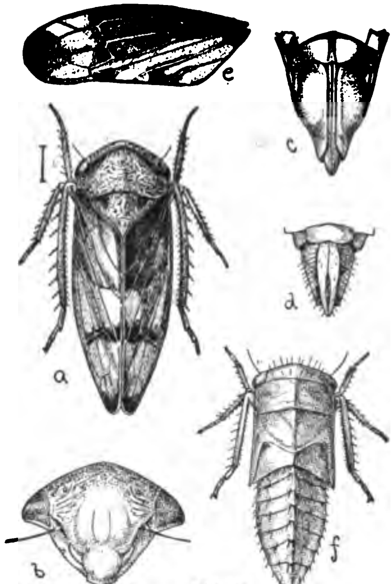


Fig. 2 B. distinctus

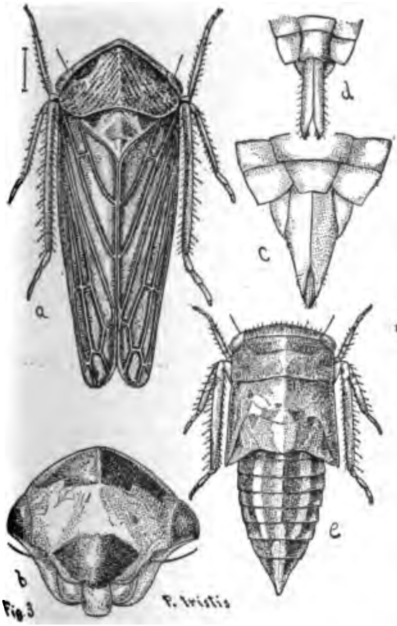


Fig. 3 P. tristis

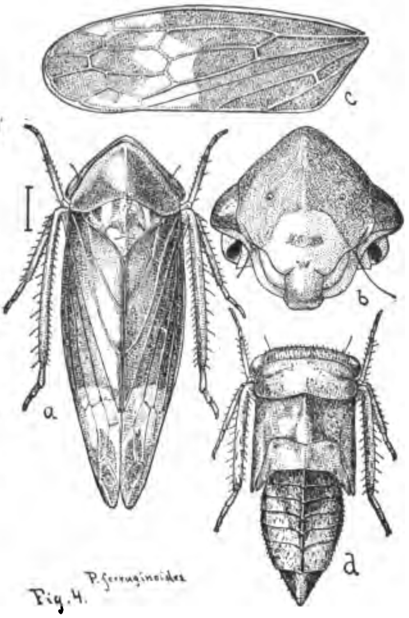


Fig. 4. P. ferruginoides

PLATE II.

found to occur most abundantly on the native plums, but have been taken from cultivated varieties. The larvæ appear in May and have all issued as adults by the end of June. The first adults appear about the third week in June and are found abundantly throughout July, disappearing before the middle of August.

Pediopsis trimaculata Fh.—This is a small, dull-brown species with from one to three pale spots on the wings, and in fresh specimens the body is covered with a yellowish bloom, making it appear much lighter. It is about one-third smaller than *tristis*, lacks the black spot on the face and the prominent veins on the wings; otherwise it is very similar in appearance.

The larvæ are like the preceding in form, somewhat smaller, reddish-brown in color, the face being entirely dark brown, there are two white stripes running the full length of the abdomen and the crest is white behind the middle

They occur on plums with *tristis*, usually in greater abundance than that species, but their color so closely mimics that of the bark, even to the powdery ' bloom" of a young twig, that unless they move they are scarcely discernible.

Pediopsis viridis Fh.—The females of this species are about one-fourth of an inch long (6 m. m.), similar in form to the others, but of a uniform leaf-green color when alive, changing to a yellowish-green in the dried specimens. The males are smaller, nearer one-fifth of an inch (5 mm.) long, and are dirty greenish or brownish in color.

The larvæ are of the usual pattern, bright green with prominent red eyes the head is about the same length throughout as at eyes, the abdomen not as strongly crested.

This is the most common species of the genus throughout the greater part of the United States, occurring on most, if not all, of the different willows The larvæ appear in May and mature the last two weeks in June, the adults from the middle of June until into August.

Pediopsis ferruginoides V.D.(Plate II, Fig. 4).—This is a very pretty rusty red species a little larger than *viridis*, being nearly one-fourth of an inch long (5 mm.). The females vary from reddish orange all over except for a large transparent spot between the ends of the wings to dark reddish brown—in this case the light spot extends clear across the wings, dividing the dark up into two parts.

The larvæ are yellow and brown in a general imitation of the adult, the head and pronotum yellow, the rest of the body brown with a transverse band across the back of the wing pads and another across the abdomen.

They occur on the narrow leaved willows, very commonly. The nymphs were found early in June from which the males began to issue late in the month and the females by the first of July. The males soon after disappeared, the females remaining through the month.

Genus Idiocerus.—This genus, like *Pediopsis*, is composed of species that occur both as larvæ and adults on different species of trees; they are also distributed over the temperate regions of the world, a large number of species occurring in this country.

Though very variable in size and color they agree closely in form, being characterized by their broad, short heads, the head across the eyes being wider than the rest of the body, the wings are long and usually narrow at the tip so that they appear wedge-shaped, very much as in *Agallia novella;* they are, however, much larger than that species and are further distinguished by the antennæ of the male, bearing a dark colored inflated disc-like portion near the tip.

The larvæ can be distinguished from those of the other tree inhabiting forms by the broad head and the long, slender abdomen which is nearly round and lacks the crest on top and the flaps on the sides of the two former genera. They are mostly two brooded, some, if not all the species, passing the winter as adults.

Idiocerus alternatus Ficth (Plate III, Fig. 1).—This common species is slightly over one-fifth of an inch (5 mm.) long, with a broad head curving around the pronotum, the middle bears a large reddish brown blotch, just outside of which on top there are two small black spots on a yellow band that extends to the eyes. The pronotum is reddish brown and usually there is a white stripe down the middle. The wings are partly transparent, the veins being dark in some places and light in others alternately, a light spot near the center of the sutural line.

The larvæ are usually greenish with brown rings on the abdomen; some few that occur in more exposed situations are brownish all over. There are four black spots in a line between the eyes in front, not seen from above. The brown rings on the abdomen are made up of about twelve hair-bearing spots on the hind margin of each segment.

The eggs are about 1 m. m. long by 1-5 mm. wide, cylindrical, slightly curved, tapering gradually to a point at one side of the smaller end and cut off obliquely to an obtuse point on the opposite side at the large end. They are deposited in the young wood near the tip of a branch usually close to a bud, sometimes singly, more often three or four near each other; in either case the twig would enlarge at the spot and finally burst open and display the end of the egg in the seam; if many eggs were deposited in a twig, as was the case in the cage experiments, it usually died, while if only a few were deposited in a place, as was the case in the field, it sometimes continued to grow although weakened and distorted. The final result on the trees under observation was that over one-third of the branches had their tips killed back or distorted, usually the main stem and the bigger branches being most affected, probably owing to their more rapid growth in the spring, offering a more favorable place for deposition than the slow growing side branches.

Life history: The adults pass the winter under the leaves and rubbish in the woods, becoming active quite early in the spring; some eggs were deposited before the middle of May, and from then on nearly through the month. The first larvæ were found the last week in May, when a number hatched in the cages and a few were found in the field, the majority not appearing until into June, the egg stage lasting nearly three weeks, in the breeding cage, where the temperature was fairly constant; probably a little longer under the changeable spring weather out of doors. The larvæ burst through the projecting top of the egg and are active from the start. When first hatched they are nearly white, except for their red eyes; the head is nearly twice the breadth of the body. Within a few days they become greenish in color and much larger proportionately. The larvæ are abundant throughout June and well into July, the adults beginning to issue the first week, and from then on through the month, remaining abundant through August. The second brood was not as closely watched. The larvæ were taken early in September, and the adults appeared soon after, remaining abundant until cold weather sent them under cover.

Idiocerus brunneus O. and B. (Plate III, Fig. 3).—This is a larger species than *alternatus;* scarcely longer, but much broader; easily recognized by its cin-

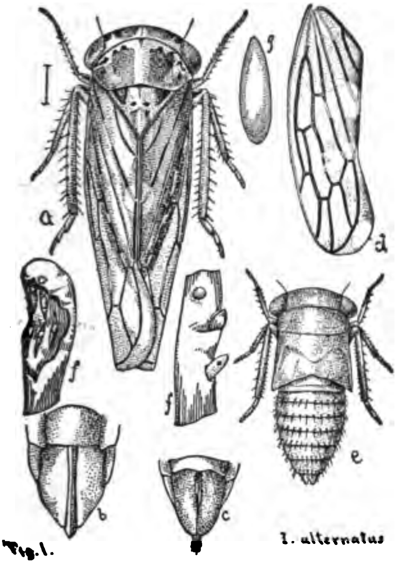


Fig. 1. I. alternatus

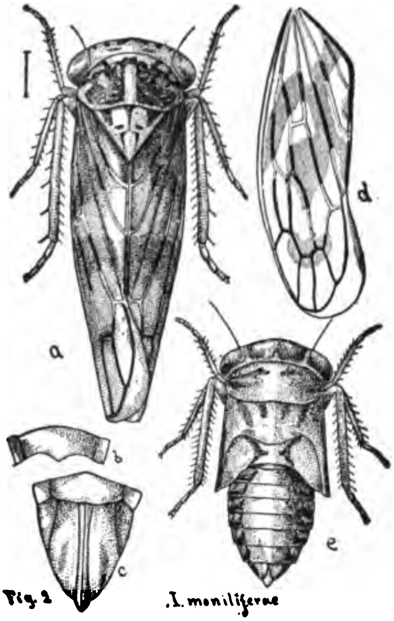


Fig. 2 I. moniliferae

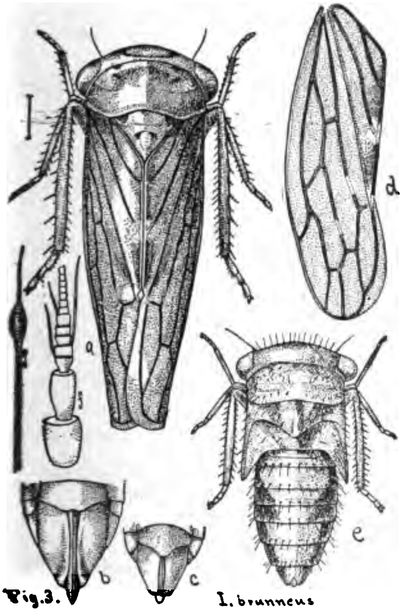


Fig. 3. I. brunneus

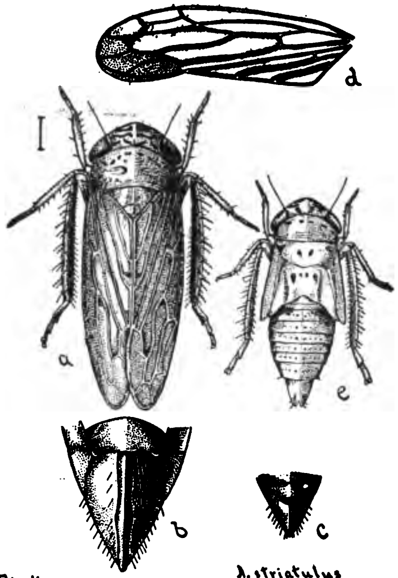


Fig. 4 A. striatulus

PLATE III.

namon brown color. The head is very broad and short, with two large black spots between the eyes, and two smaller ones including the ocelli. The larvæ are very distinctly colored, being dark reddish-brown on the sides and across the wing pads, leaving a nearly round reddish or yellowish spot on the head and pronotum, another on the abdomen between the wing pads, and an egg-shaped one behind, or the last two may unite. The whole body is covered with long, coarse hairs, and the antennæ have a black spot, as in the adult.

This species also occurs on willows, along with the preceding. The larvæ become full grown in June and September, the adults being most abundant in July, and again in the fall.

Idiocerus monoliferæ O. and B. (Plate III, Fig. 2).—This is a larger species than *alternatus*, and usually somewhat darker; over one-fifth of an inch (5.5 mm.) long and one-twelfth inch wide across the head. The head is yellowish on top, with two black spots. Below this, on the face, is a black band from eye to eye. The pronotum is dark reddish-brown, with a light stripe in the middle and a spot on each side. The scutellum has a black spot in each corner, and two small ones in the middle. The wings are nearly transparent, milky, with the veins black and white alternately in three rows of each color, being black at the tip and light at the base.

The larvæ are large, well marked forms. The top and sides of the head are dark brownish; near the middle a yellow patch, with two large black dots, these dots much nearer each other than in the adult. The body is yellowish, with a pair of brown spots on the pronotum, a few brownish marks on the wing pads, and the sides of the abdomen brown, leaving an oblong yellow patch on the top.

The larvæ were found on cottonwood trees early in July. They were over half grown, and the adults appeared toward the last of the month. The larvæ and adults are both well adapted in color to the mottled appearance of cottonwood bark.

Idiocerus verticis Say.—Still another species occurring on willow, and closely resembling a small *alternatus* has been referred here. It is considerably smaller than *alternatus* and lacks the black marking of the head except for two black dots; the pronotum and wing are light while the scutellum bears a black spot in either angle. The larvæ have not been determined. The adults appear the last of June and again in September.

Idiocerus snowi G. and B.—This species is somewhat larger than *alternatus* being over one-fifth of an inch (5 mm.) in length, the head is not as broad or as rounding, being only slightly curved in front, color green, the eyes reddish brown, a stripe down the suture of the wing, and two small round spots on the head black.

The larvæ are stouter and have blunter heads than the former species. They are entirely light green except the eyes, which may be blackish, and two black spots on the head between them. They have the row of hairs on each abdominal segment as in *alternatus*, but they do not arise from black spots, and the second pair of black spots on the head of that species is never present,

This species has been found abundant on willows in sheltered situations and it is probable that it will be found to be a more southern species than the preceding one. The larvæ were taken in June, becoming full grown by the last of the month. The adults were found very abundantly from the last week of June on into August and again late in September and on into October.

Idiocerus maculipennis Fitch.—This is a very bright, chestnut brown species with light markings. The head is very short and the eyes curve around the pronotum and do not stand out as in the willow species; the face is light yellow with a red stripe down the middle and two large black spots on the sides above. There is a light spot on the pronotum, a V-shaped mark on the scutellum, and another of the same color on the wings; the outer margins of the wing are very dark except for a white patch before the tip.

The larvæ are dark reddish-brown, sometimes blackish in color, with broad blunt heads and prominent eyes. They are very active and though readily seen they are very hard to capture, dodging around a limb whenever approached.

They occur very commonly on hawthorn and crab apple trees, the larvæ appearing in May. The earlier ones mature in the middle of June and the last in the early part of July, the adults being common in the latter part of June and through nearly all of July. The adults were again common the last of August and early in September.

Idiocerus provancheri V. D.—Very similar in form and color to the preceding, color more of a reddish-brown with a large oblique patch at the base of each wing yellow. They occur in less numbers along with *maculipennis* and evidently have about the same life history. The larvæ are not separated from those of the other species.

Idiocerus cratægi V. D.—This species also occurs on the same trees as the two preceding, and usually in as large numbers. This season it was rarely met with, however, and no larvæ were found. It is probably two-brooded as with the others, as the adults have been taken in former years both early and late in the season.

The adults are rather shorter and blunter than the other two and are light green with six black spots in two rows, two on the head, two on the pronotum and two on the scutellum.

SPECIES AFFECTING GRASS CROPS.

Genus Athysanus.—The members of this genus are, like those of *Deltocephalus*, confined to grasses for food plants, both in larval and adult stages. Most of those under observation have been found to be very closely limited to one kind of grass, and usually adapted both in size and color to harmonize well with their surroundings. It is hard to define the group as a whole, but they usually possess bluntly pointed heads and broad wings, which may be longer or shorter than the body, often both forms occurring in the same species.

A number of the species have been found to have but one brood in a year. The most of these, as *comma*, *colon*, *striatulus*, *magnus*, etc., occur as larvæ in the early part of summer, maturing soon after the middle of June, the adults common on into August, depositing eggs which remain over winter. *Extrusus*, however, passes the winter as a larvæ and matures in early spring, the adults common from the 1st of May until into July. Of some of the smaller species, as *curtisi* (Plate IV, Fig. 1) and *obtutus*, two broods is the probable number, though little can be added to the former report, except that in the case of *curtisi* the first brood of larvæ appear early in May, the adult males appearing the second week in June and the females the third, continuing abundant into August. From this time on the larvæ of other species interfered with accurate observations, as in the former case. The larvæ spoken of as occurring in July must have been of some other species.

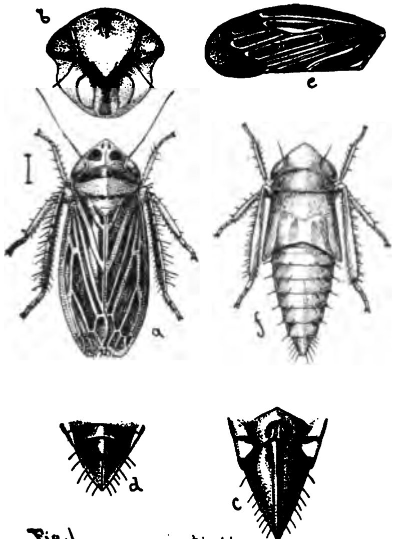


Fig.1 A.curtisii

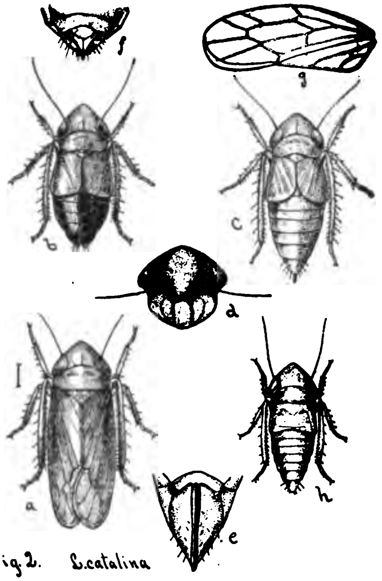


Fig.2. L.catalina

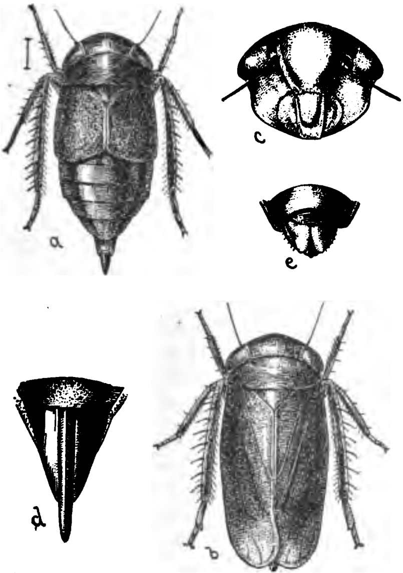


Fig3 D.gammaroidea.

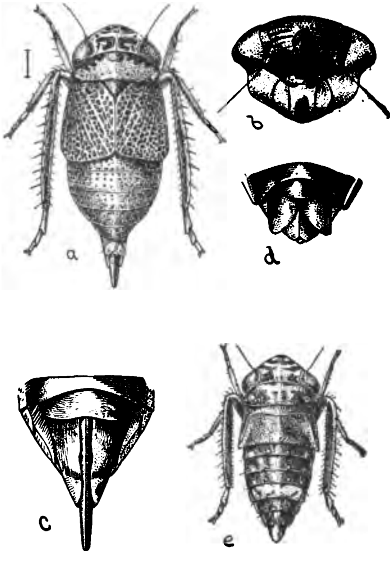


Fig.4. D.robusta

PLATE IV.

Athysanus extrusus V. D. (Plate V, Fig. 1).—Stout and short, over one-fifth of an inch (5 mm.) long and nearly half that wide, head short, no longer than the pronotum, wings shorter than the body in one form which does not fly—longer with the wing fully developed in the other form which flies readily. Color, brownish-yellow to dirty straw, usually with four irregular dark marks on the head. The male is somewhat shorter than the female and has a pair of long strap-like styles extruded from the abdomen behind.

The larvæ are short active forms, yellowish with reddish and fuscous markings after moulting, darkening up until they reach a chocolate brown with fuscous markings on the head and four rows of white spots on the abdomen. The legs and body are sparsely clothed with long stiff hairs.

Life history: They are found only in shaded locations, occurring most abundantly on rich bottom land pasture where the underbrush has all been cleared out, leaving only the larger trees. Here the larva were found January 1st, less than one-third grown. The day was warm and they were very active. They were again observed about the first of April. Spring had fairly opened and they were a little larger than during the winter. They mostly moulted April 6th and again April 14th; the first adults began to appear about the first of May, these being males; the females began to appear a week later, and by the middle of May they had all issued. The adults were abundant from then on into July. Frequent examination showed that the eggs were not deposited until late in June or July, from which the larvæ hatch late in the fall and pass the winter in the larval state.

Athysanus striola Fall.—This species somewhat resembles the preceding in size and striation of the head, but is otherwise quite distinct; the head is much broader than the body, which tapers back to the narrow tip of the wings, color green, tinged with yellow, a narrow black line across the head between the ocelli and the margin black, sometimes a curved line on the pronotum dusky.

The larvæ are olive brown with markings almost as in the adult, the head is more pointed and there are two dots between the stripe and the margin and two more against the eyes.

This species occurs only on low swampy ground; a few full grown larvæ and an abundance of adults were found on a low, swampy meadow where a species of *Juncus* abounded.

Athysanus striatulus Fall (Plate III, Fig. 4).—Another slender species, with long wings reaching well beyond the abdomen, about one-sixth of an inch (4 mm.) to the tip of the wing in the female, the male being shorter and much smaller; testaceous brown, with dark markings on the pronotum and wing; markings arranged in about three interrupted rows, sometimes obscure.

The larvæ are narrow, brownish forms, with a slightly more pointed head than the adult; the dark markings are nearer the margin, except two spots near the base; there is a row of spots across the pronotum, two pairs of large spots on the wing pads, and a smaller pair between the posterior ones.

This species is found abundantly over grass areas of the prairie in various parts of the state. The larvæ were found very common the last of May and on into June. The males began to appear by the middle, and the females a week later. The males disappeared by the second week in July, the females remaining until into August, the eggs having been deposited before the end of July.

Lonatura catalina O. and B. (Plate IV, Fig. 2).—This is a very small species —so small that one cannot determine without a magnifying glass whether it is an adult of this or the larva of some other species that is under consideration. It presents a very good illustration of the adaptation of the size of the insect to the size of the host plant. It is also interesting from the fact that it occurs in many different forms and colors, each one being essential to the existence of the species. It is in this respect somewhat comparable to a colony of ants. The most common forms are the short winged ones, in which the outer wings only cover about one-half of the abdomen and the inner ones are mere scales. These forms cannot fly and are never found away from a colony.

The females are about one-tenth of an inch long (2.5 mm.), and are of a light brown-yellow color; the males are scarce one-twelfth of an inch long, and are of two kinds, one a bright orange-yellow and the other brownish black with a touch of yellow on the head. Besides these, there are long winged forms, in which both pairs of wings are well developed and extend beyond the body. The females are grayish-yellow, while the males are dark brown or nearly black.

They are found on the species of *Sporobolus* that form rather thick, mat-like patches of grass, and there they occur in marvelous abundance. The larvæ appear before the middle of May, similar in form to the short winged females, nearly white when small, becoming a lemon-yellow when full grown. From these larvæ both the long and short winged adults appear before the middle of June. The short winged forms are the most numerous, and remain through July, depositing eggs for the second brood. The long winged forms remain for a few days where they have hatched and then fly away to start new colonies. The second brood of larvæ appear in July, from which the adults issue in August and remain through the fall. There appear to be fewer long winged forms in the fall than in the spring brood.

They have been collected at Burlington, Little Rock and Sioux City, Iowa, as well as at Yankton, S. D., as commonly as at Ames, and they will probably be found to have as wide a distribution as the species of grass upon which they occur.

As the grasses affected by this species are in some places of considerable value for pasturage, this insect assumes an economic importance far out of proportion to its insignificant size.

Driotura gammaroidea V. D. (Plate IV, Fig. 3).—This is another species that occurs in several different forms. Though not as abundant where it does occur still it has been found from Iowa and Minnesota to Colorado and Wyoming, and as far south as Kansas, this probably due to its larger size, rendering it more readily recognized.

The short-winged one occurs in two color forms, the more common one being shining black while the other one has the tip of the abdomen and the short wings that cover less than half of the abdomen orange yellow, the rest of the body being shining black. The females are about one-sixth of an inch (4 mm.) long and about half that wide, with a plump body and a short head; the males are shorter and rounder, the long winged form is shining black with broad leathery wings that reach to the tip of the abdomen. The wings are very broad at the tip and make this form appear much larger than the short winged form with its tapering abdomen.

They appear on upland prairie regions where the grass most abundant is *Andropogon scoparius*, and though there are usually a number of grasses mixed with this the probability is that this is the host plant. This species has not been found where this grass does not occur, and is most common where there are but few other grasses present. The larvæ are very much like the short winged forms, the head is a little wider and the abdomen has a few coarse hairs. They pass the winter nearly full grown and issue as adults early in the spring. The eggs are slightly more than one mm. long, cylindrical two-thirds their length, tapering to a rounding point. They are deposited about the middle of May, from which larvæ appear in June, maturing about the first week in July and continuing for about two months. Larvæ appear the latter part of August and early September, becoming nearly full grown to pass the winter

Driotura robusta O. and B. (Plate IV, Fig. 4).—Another and very similar species to *gammaroidea* was found as adult and full grown larvæ at Little Rock and Sioux City, Iowa, and at Sioux Falls, S. D., the first week in July, and larvæ were taken at Audubon along with those of *gammaroidea* September 25th, indicating that it has a similar food habit and life history. It has also been received from Colorado.

The short winged forms are similar in size and general appearance to those of *gammaroidea* but for their gray color, being finely and irregularly mottled with black on a light ground; there is a complete collar across the pronotum and down around the lower part of the face. The larvæ are reddish-brown with light stripe across the face and another across the abdomen behind the middle.

Dorycephalus vanduzeei O. and B. (Plate V, Fig. 2).—Another still more grotesque species than *platyrhynchus* was found on high upland prairie at Little Rock, Iowa, July 1st. This makes the second species of this remarkable genus for Iowa and the third for the group, the only other known species having been found near the Ural river in Russia.

This species is considerably over half an inch (14 mm.) long and only about one-tenth as wide; the wings in this form are about one-third the length of the abdomen, hardly as long as the head, and can be of no use. The head is long and leaf-like, the entire insect much resembling a straw. Two females were taken from the place where the most abundant grass, and the only one that would appear to have a stem large enough for the deposition of their eggs or for the adults to rest upon was *Sporobolus cuspidatus*. If their life history agrees with that of *platyrhynchus* those taken were the last of the single brood, the males having disappeared before. They will doubtless be found to have a long winged form, as the species could not survive without some means of distribution and it seems probable that all the males will be long winged forms as in *platyrhynchus*.

Phlepsius altus O. and B. (Plate V, Fig. 3).—This is a shorter and stouter species than *irroratus* with a shorter rounder head and broader wings which are generally flaring at the tip. The head is only a little longer in the middle than at the eyes, about half the length of the pronotum. General color dark reddish-brown, from the innumerable fine lines and spots on a light ground, a number of clear white spots on the wings and a row of alternate white and black spots on the outer margin. The species of this genus are very much alike in color and it is only by very careful study of structural characters that they can be separated The broad short form of this species, however, separates it from the other species occurring in Iowa.

The larvæ are very broad and short, even more so than the adult, the head being longer proportionately. They are of a dark grayish-brown, sometimes with a reddish cast, being in fact dirt color as near as that color can be imitated. They are found in abundance wherever *Bouteloa hirsuta* (Blue Grama) occurs. In Iowa this grass is only found on the high prairie land, usually capping the hills, so that this species has a somewhat local distribution. Further west where the Grama grasses form a large part of the grazing this species may be expected to occur very generally. The species is single-brooded, the larvæ appearing by the middle of May as small almost round gray specks clustered on the ground around or in among the stems of the grass clump, springing a foot or more away if disturbed. Toward the last of June they become full grown and may be found on the ground under the edge of the clump so closely resembling the dirt and rubbish as to be scarcely noticeable. The adults appear the last week in June and the first week in July and remain in decreasing numbers through August.

Phlepsius nebulosus V. D. (Plate V, Fig. 4).—Very similar in form and color to *irroratus* but much larger, being about three-eighths of an inch (9 mm.) long and about one-fourth that broad; the head is less broad and less pointed and much thinner on the edge.

The larvæ are broad and flat with longer and flatter heads than the adult, the abdomen tapering to a sharp point, clear creamy yellow with innumerable fine brown points arranged in wavy lines, a light stripe down the middle and three rows of spots on each side of the abdomen, the outer row with black margins. The eyes are dark red and there is a dark spot on either side of the tip of the head.

Nearly full grown larvæ were found the third week in June in clumps of *Panicum virgatum* (Switch grass) feeding upright on the broad stems which they much resemble in color. Placed in the cage they issued as adults the first of July. Adults were taken from the last of June through July, seeming to stay closely to low ground where the grass occurs.

EXPLANATION OF PLATES.*

PLATE I.

FIG. 1.—*Agallia 4-punctata:* *a* adult; *b* nymph, lateral view; *c* nymph; *d* face; *e* wing; *f* female, *g* male genitalia.

FIG. 2.—*Agallia novella:* *a* adult; *b* lateral, *c* dorsal view nymph; *d* face; *e* wing; *f* female, *g* male genitalia.

FIG. 3.—*Agalla sanguinolenta:* *a* adult; *b* lateral, *c* dorsal view nymph; *d* face; *e* wing; *f* female, *g* male genitalia.

PLATE II.

FIG. 1.—*Macropsis apicalis:* *a* adult; *b* face, *c* female, *d* male genitalia; *e* nymph; *f* eggs in bark; *g* eggs greatly enlarged.

FIG. 2.—*Bythoscopus distinctus:* *a* adult; *b* face; *c* female. *d* male genitalia; *e* wing; *f* nymph.

FIG. 3.—*Pediopsis tristis:* *a* adult; *b* face; *c* female, *d* male genitalia; *e* nymph.

FIG. 4.—*Pediopsis ferruginoides:* *a* adult; *b* face; *c* wing; *d* nymph.

PLATE III.

FIG. 1.—*Idiocerus alternatus:* *a* adult; *b* female, *c* male genitalia; *d* wing: *e* larva; *ff* eggs in twig; *g* egg.

FIG. 2.—*Idiocerus moniliferæ:* *a* adult; *b* female. *c* male genitalia; *d* wing; *e* nymph.

FIG. 3.—*Idiocerus brunneus:* *a* adult; *b* female, *c* male genitalia; *d* wing; *e* nymph; *f* base, *g* tip of male antenna, greatly enlarged.

FIG. 4.—*Athysanus striatulus:* *a* adult; *b* female, *c* male genitalia; *d* wing, *e* nymph.

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* All the figures in these plates are from drawings made under the direct supervision of the authors by Miss Charlotte M. King. All figures are enlarged, the natural size being shown by hair lines at side.

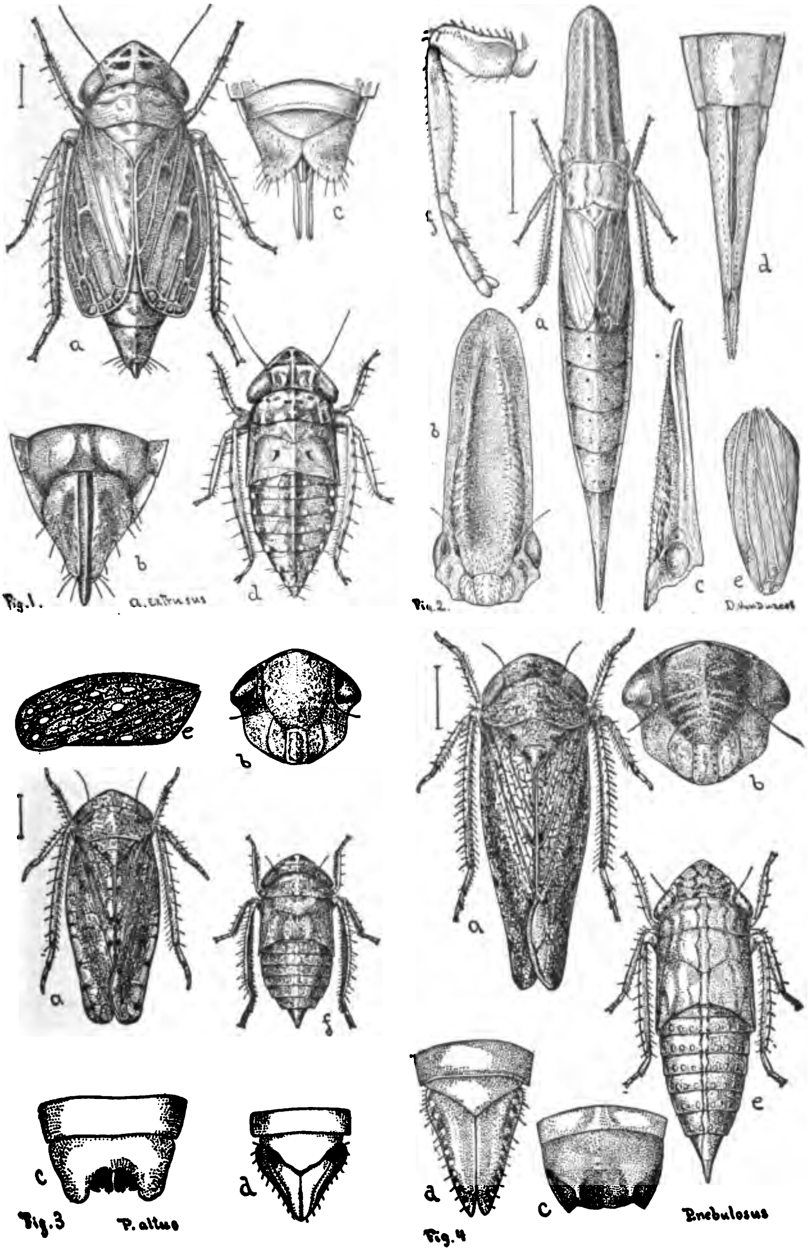
Fig. 1.
a
b
c
d
a. extrusus
Fig. 2.
a
b
c
d
e
f
D. Van Duzee
Fig. 3
P. altus
a
b
c
d
e
f
Fig. 4
a
b
c
d
e
P. nebulosus

PLATE V.

PLATE IV.

FIG. 1.—*Athysanus curtisii:* *a* adult; *b* face; *c* female, *d* male genitalia; *e* wing; *f* nymph.

FIG. 2.—*Lonatura catalina:* *a* long-winged female; *b* short-winged male; *c* short-winged female; *d* face; *e* female, *f* male genitalia; *g* wing; *h* nymph.

FIG. 3.—*Driotura gammaroidea:* *a* short-winged female; *b* long-winged female; *c* face; *d* female, *e* male genitalia.

FIG. 4.—*Driotura robusta:* *a* adult, short-winged female; *b* face; *c* female, *d* male genitalia; *e* nymph.

PLATE V.

FIG. 1.—*Athysanus extrusus:* *a* short-winged female; *b* female, *c* male genitalia; *d* larva.

FIG 2—*Dorycephalus vanduzei:* *a* adult; *b* face; *c* lateral view of head; *d* female genitalia: *e* wing; *f* leg.

FIG. 3.—*Phlepsius altus:* *a* adult; *b* face; *c* female, *d* male genitalia; *e* wing; *f* nymph.

FIG. 4.—*Phlepsius nebulosus:* *a* adult; *b* face; *c* female, *d* male genitalia; *e* nymph.

BOTANICAL SECTION.

L. H. PAMMEL IN CHARGE.

I have the honor to report concerning the work of the botanical section for the biennial period. The botanical staff has given most of its time to a study of grasses, as this constitutes an important item for the farmer of Iowa. No other single agricultural product has as much value as the grass and hay crop. We have in connection with the chemical section, studied not only the more important native grasses, but the cultivated as well. We have also made a special study of weeds, especially mustards, since many complaints were made in different parts of the state that these were a great menace to the proper cultivation of crops. A considerable portion of our time during the past year has been devoted to a study of corn. This work contains an account of smut, its injuries, corn rust, and other diseases. We have also considered the relation of corn to climate, and the improvement of our corn.

We made some extensive experiments in the germination of corn. It was observed that much of the 1895 crop germinated well, but the poor stand in many cases was due to abnormal and unseasonable weather.

Mr. Ball has given special attention to a study of commercial seeds. In many cases seeds are not up to the required standard as regards germination.

Mr. Combs has made a careful study of alfalfa spot disease, one of the most destructive enemies of the alfalfa.

Jointly with Mr. Mead a paper was published on germs found in milk as delivered to the creamery. Tainted milk was due to bacteria. These germs, when isolated, had very characteristic odor.

HORTICULTURE AND FORESTRY SECTION.

J. L. BUDD IN CHARGE.

In experiments with new varieties of vegetables, cereals, or small fruits, important results can be reached in five years. But this is not true of experiments with forest trees, fruit trees, or ornamental trees and shrubs. The recent dry seasons and the general lowering of the water level have materially added to the value of the results of trials of forest trees, fruit trees, ornamental trees and shrubs planted from fifteen to twenty-one years ago on high and low land. At this time only some very brief summaries can be given, on account of limited space.

FORESTRY PLANTATIONS.

In 1876 and 1877 about ten acres were planted with our leading native forest trees, four feet apart each way. The land selected was four knolls with thin soil, with the parts of the valleys between dry enough for plowing. The trees were all well cultivated until the tops shaded the ground fairly well. During the first ten years all species grew well on the high and low lands. With the advent of the dry season the trees were thinned on three of the knolls, while the fourth one, planted with green ash, has been left for thinning itself by the survival of the fittest. On knoll No. 1, where the box elders have died or dwindled to scrubby, dwarfed specimens, as a rule, and the Catalpas are not much better, other species have made growth as follows: Black oak, 43 inches in circumference, one foot above the ground; Riga pine, 43 inches; basswood, 39 inches; Austrian pine, 36 inches; red cedar, 23 inches; catalpa, 21 inches. In the case of the box elder and catalpa, the trees measured were the exception and not the rule. In the other cases, average trees, not too much crowded were taken. On low ground at base of knoll the box elder, catalpa, basswood and hard maple have made large and even growths.

On knoll No. 2, the plantation was made largely with white pine and European larch, alternated with box elder and green ash. These nurse trees have been crowded out, as a rule. But where standing in open spaces on the hill they are small in size, low and scrubby. The white pine on the hill is the king tree. Many of the trees are 44 inches in circumference and 50 feet in height. The best larches are 37 inches around, and about as high as the pines. Both these species show an even stand, and are as good on the high as on the low land. On the low land the box elder and the ash have held their own.

Knoll No. 3 was planted largely with black walnut and butternut alternated with box elder, white elm and green ash, with some black wild cherry. On the bottom black walnuts stand fifty feet high with stems twenty-nine inches around. The only tree among them not crowded out is the white elm which in height and thrift is nearly its equal. In open spaces at some distance from the walnut the box elder is equal in diameter, but not in height. As we get on the hill the black walnut is dwarfed in size and bearing very diminutive nuts, and many have died from effects of the drouth. The butternuts grew well on the hill until the drouth came, but now are dead or have dead tops. As the belief twenty years ago was that the butternut was a high land tree no specimens were planted on the low land. The only good thrifty trees on this hill are the European larch and black wild cherry. All through this plantation the black walnut has crowded out and dwarfed or killed all species except the white elm, larch and black wild cherry.

On the fourth knoll, with adjacent valleys, green ash was planted exclusively. With twenty years' growth the largest trees on low land are twenty-five inches in circumferenee. On the high ground the trees stand much better than where alternated with black walnut, white pine and larch, but they are small in size. It is now evident that this plantation would have been materially benefited by thinning ten years ago to eight feet each way.

CONIFERS ON THE CAMPUS.

Of the conifers planted on the campus during the past twenty years the species that have retained thrift and beauty in isolated positions in blue grass sod are white spruce, Black Hills spruce, silver spruce (Picea pungens), Douglas spruce, Douglas fir, Concolor fir, white pine, Black Hills pine, dwarf mountain pine, red pine, Riga pine, and some specimens of Austrian pine. Seedlings of the latter species seem to be variable in ability to endure extremes of temperature and moisture of soil. The black spruce, Norway spruce, common Scotch pine, common fir and American and European larch do not stand drouth as well in isolated positions in sod as in the timber plantations.

EXPERIMENTS WITH PLUMS.

Twenty-one years ago we found on the college farm a plantation of the Miner plum with some half dead specimen trees of the Lombard. In the Iowa nurseries at that time these were the leading varieties. During the succeeding six years we picked up several native varieties that had neighborhood notoriety. As instances we secured scions of De Soto from Wisconsin, of Rolling Stone from Minnesota, of Wolf from Page county, of Comfort from Pottawatamie county, of Wyant from a town lot at Janesville, Iowa, of Bixby from Edgewood, Iowa, of Maquoketa from Washington county, Forest Rose from Missouri, and the Pottawattamie from west Iowa. Some later we added to the trial orchard the Cheney from LaCrosse, Wis., the Hawkeye from H. A. Terry in west Iowa, Harts' De Soto from Clayton county, and other native sorts. At the summer meeting of the State Horticultural society, at Ames, fourteen years ago a majority of the members had never before seen a collection of fine native plums. It gave an impetus to their culture, as did also our distribution of these varieties to amateurs in a small way over the whole country.

In 1883 we introduced a number of varieties of the plum from Russia. These were also distributed in a small way. As none of the European plums came into bearing as soon as our natives, the Russian plums have been severely denounced by some nursery men. As it now appears they will have their greatest value in the south half of Iowa. At our last state fair the largest and best plums shown were of these varieties, and we have hundreds of reports from those who planted ten years ago like the following from B. O. Curtiss, of Paris, Ill.: "The Russian plums have come to stay. I have been planting them now for ten years and have not lost a tree. The Russian plums I have are all hardy, productive and superior in quality. The English plums, like Lombard, are tender in tree and are winter killed when cold enough to kill peach trees." Over 500 amateurs in the south half of Iowa, Illinois and Indiana have made similar reports on about ten Russian plums and prunes that bear large and good fruit. Some of these are freestone and 2¼ inches in diameter. At Ames the past season the native plums were a failure while some of the Russians were well loaded.

HARDY PEACHES.

In 1883 we received some peach pits from Bokara in Central Asia and some scions from northwestern China. About ten varieties of these have proven at least 30 per cent hardier than any of the old varieties, and their fruit is large, freestone, and best in quality. We have had over 500 reports from the south half of Iowa and Illinois as favorable as the following: Hon. Silas Wilson, of Atlantic, says of Bokara No. 3, that it is fully 30 per cent hardier than any of the old sorts and the abundant crop of fruit is of the largest size, freestone, and high in quality. M. J. Wragg, of Waukee; Dr. Powell, of Glenwood, and many others have reported the trees hardy, fruitful, and that many of the specimens measure from ten to eleven inches in circumferences. Near Ames the trees planted twelve years ago are still alive and fruitful and even the past season were laden with fine fruit.

RUSSIAN CHERRIES.

A number of the varieties of the cherry were introduced by the writer from northeast Germany and south central Russia in 1883. They have been widely scattered in small lots for trial and some of them are a success across the continent and some good varieties have proven hardy in north Iowa and even Minnesota and North Dakota. In Ames the past season near thirty varieties were laden with from two to four bushels of fruit. Some visitors from Rochester, N.Y., said that they had never seen so many fine varieties loaded with fruit in any one locality. Hon. J. G. Berryhill was also a visitor and made the same report. All amateurs, not prejudiced in favor of the old varieties as propagators, report in regard to quality as does A. H. Terry, of Crescent, Iowa, who is an acknowledged judge of fruit. He says: "At Crescent not one of the Russian varieties will probably excel the Early Richmond in bearing, but in size and quality the most of them are vastly superior."

When the college no longer sends out trees at a small price, as will occur after the spring of 1898, the superior hardiness of tree and size and quality of fruit will no longer be questioned. As it now stands it is admitted by all that they will thrive and bear where the old varieties are a total failure.

RUSSIAN APPLES.

The college began to send out the most promising varieties of Russian apples about sixteen years ago in a small way to those who agreed to give them careful trial and in due time to report on their behavior. They are now being reported on by over two thousand experimenters across the continent. The amateurs everywhere report prizes among them. This is true even in South California and Florida. But their main value will be in the cold north where of the old sorts only the Duchess and Wealthy succeed. In Minnesota the whole recommended list at present are Russian varieties or Russian seedlings. In north Iowa we have many reports like the following written by M. E. Hinkley, of Marcus, Iowa, after a visit in the orchard of P. F. Kinne, of Storm Lake, in north Iowa. He says: "The annual production for three years past has been from seven to ten hundred bushels. A dozen Russian sorts, all heavy bearers, are the special pride of the owner. Other fruit ventures in this vicinity lead to the belief that Storm Lake will be the Glenwood of north Iowa."

Mr. Kinne writes: "Without the Russians, orcharding of all kinds would be a failure in north Iowa. With them, the north has great possibilities." As it now stands, each experimenter has from one to ten prized varieties. Even Mr. C. G. Patten, of Charles City, says of the Good Peasant: "It is a beautiful apple. The tree is as hardy as Duchess, and for both eating and cooking is of good quality. Its season is from December to February." When summed up, as reported by 100 reporters, who have had them on trial for fifteen years, we find fully ninety varieties bearers of fine fruit for all seasons. As the years go on this statement will be more than verified. As to winter varieties, the statements made in Bulletin No. 3, of the Iowa Experiment station, are correct. As an instance, we say of Regal (No. 169): "A fine tree and early bearer. Fruit of medium size, and much like Rawle's Janet in color and flesh, and it keeps as well in north Iowa as the latter does when grown in the south district." Mr. P. F. Kinne, of Storm Lake, says of it: "No. 169 is my pet winter apple, as yet. The tree is as hardy as Duchess; the fruit is of fair size, and it keeps like Ben Davis." Of No. 410 (Repka Malenka), we say: On dry soil, as hardy as Wealthy; season, late winter here, and at the north it has been kept until the next July.

Mr. J. F. Swartzendruber, of Kalona, Washington county, Iowa, says of Repka Malenka: "It is perfect in tree, in heavy bearing, and as a long keeper; fruit of medium size, well colored, mild sub-acid, and good for the table or kitchen. It is good in October, but keeps in perfect condition until April, and even later."

In like manner we have reports from amateurs in regard to the keeping qualities, even in south Iowa, of Voronesh Rosy, Bogdanoff, Red Queen, Winter Aport, Boiken, Sklanka, Volga Cross, Zuzoff Winter, and a number of other varieties hardy in the north.

Among the benefits connected with our wide distribution of the Russian apples, not the least one is the opportunity it gives for natural and artificial crossing with our old standard varieties. From them will come in the near future the hardy varieties that will defy the test winters, and yet higher in quality of fruit than some of the leading varieties now grown in the southwest.

HARDY PEARS.

The pear in all countries does best on high ground, with good air drainage. The Russian pears introduced by the college in 1883 are as hardy in tree as the Duchess apple. On high ground, in north Iowa, they grow rapidly; start each spring from the terminal bud, and in due time produce from fair to good fruit. Those who have planted in low ground, with black soil, have usually lost their trees by blight. Some of the hardy varieties are really good in quality. As in instance, W. H. Guilford, of Dubuque, writes: "The Gakovsky (No. 347) pear you sent me bears well; is hardy, and free from blight. It is small, but really of high quality. This variety has made such a reputation here among orchardists that the demand for the tree cannot be supplied."

We have many reports as favorable of other varieties where planted on exposed ridges at the north. In south Iowa the variety most generally commended of our distribution is the Mongolian Snow pear. This has done well in the south half of Iowa, on all dry soils, and it is a fruit of good size and high quality.

SHRUBS AND ORNAMENTAL TREES.

As far north as Winnipeg and Indian Head in northwest territory, we have distributed many fine flowering shrubs and small ornamental trees introduced by the college from Europe and the Amur valley in Asia. Professor Hays of the Minnesota Agricultural college said last week while visiting Ames: "On my trip to Manitoba and Indian Head last summer I was surprised to find in perfect condition fine trees and shrubs sent out from Ames, such as a dozen varieties of caragana, the Russian snowball, Amur roses, some spiræas, half a dozen species of the barberry, several honeysuckles, Russian lilacs, the Shrubby Artemesia and several others. Scarcely a nursery catalogue can be found in the northern states that does not advertise some of the shrubs of our distribution.

OUR HYBRID FRUITS AND SHRUBS.

Our most promising crosses and hybrids are from prepotent ironclad mothers that come near to reproducing from seed. As examples, we crossed the blossoms of the wild rose of east Europe (*Rosa rugosa*) with pollen of our best garden varieties. The results have been a surprise, as in one generation we have secured double flowers and yet retained mainly the vigor and hardiness of the wild rose. With the gooseberry, we crossed the blossoms of the wild species of Manitoba with pollen of the Champion. In this case, about all the hybrids bear fruit of the size of the Champion, yet we retain mainly the hardiness of bush of the mother plant.

With the apple, we have used prepotent mothers, such as Hibernal, Duchess, and the Anis, and pollen of our best known winter varieties. As far as yet fruited, the fruit largely follows the variety used for pollen, and leaf and tree mainly follow the mother. In our work of hybridizing the plum, we have used our best native varieties for mothers, and the pollen of the Japan varieties, mainly for the reason that the European sorts do not seem to cross readily with our native species. With cherries and other fruits, we have adhered to the same principle of using prepotent ironclad mothers, and pollen from the best known sorts.

CONTEMPLATED WORK.

After the spring of 1898 the distributions to trial stations at a small price of fruit trees and shrubs now widely under trial will be discontinued. The purposes of their distribution are now accomplished. After testing and selecting, the new hybrids and crosses found worthy will be sent out to trial stations and those interested in advancing horticulture. The work of crossing will also be continued, as it is a very promising field of work in the prairie states since the advent of fruits hardier than the Duchess apple. Moretime will also be given to experiments in culture, object lessons in cordon and other training of trees and shrubs, and the extension of the college arboretum collections of shrubs and not least tabulating and recording the results of our trials and distributions to trial stations during the past twenty years.

REPORT OF THE VETERINARY SCIENCE SECTION.

DRS. M. STALKER AND W. B. NILES IN CHARGE.

Those who have interested themselves in the plan of organization of the Iowa Experiment station are acquainted with the fact that the several sections into which the station work is divided are presided over respectively by professors in charge of corresponding departments in the College of Agriculture and Mechanic Arts. A veterinary section is thus provided for. The work of this division has been directed to the accomplishment of two objects, both, of course, relating to diseases of domestic animals. The first is the ascertaining of causes, the methods of control and the treatment of diseases of an obscure nature; in other words, the work of original investigation. The second is the dissemination of useful and practical knowledge to the farming classes.

The legitimate field for this line of work seems naturally to be with communicable diseases, as only those maladies which assume epizootic proportions are liable to entail losses of a serious nature. Fortunately there are few diseases affecting our domestic animals that are so readily communicable or so fatal in their effects as to be cause of special anxiety to our farmers. Under restrictive legislation Texas fever has ceased to be in any sense a dangerous scourge, and only occasional isolated outbreaks occur from shipment of infected animals within our borders from across the danger line. Glanders and farcy among horses are practically exterminated in the state, though the writer found half the counties infected about a dozen years ago. Since the tuberculin test has been applied to the detection of tuberculosis, that disease is being hunted out in our dairy herds and on the breeding farms, and should the best knowledge on this subject be carefully and systematically applied to its control, the worst of all diseases affecting man and the lower animals will soon be materially restricted in its ravages. Swine plague and hog cholera, which probably cause more loss in this state than all other diseases of livestock combined, still exist without adequate remedy. It is not rational to expect a remedy for these maladies in the form of medicines for the cure of the disease. There is nothing in medical science to justify such expectation. The writer has claimed for fifteen years that the ultimate solution of the problem will be found in a rigid system of restriction and systematic disinfection. When the same system of sanitary police supervision is exercised over this disease that is now in use for the control of scarlet fever in every well regulated city, it will disappear with astonishing rapidity. What are known as cornstalk disease and pseudo rabies still make their periodic appearance among our cattle. Both of these diseases furnish abundant undiscovered fields for the scientist. This department called the attention of the general government to these diseases some years ago, but the scientific explanations as to causes and remedies are still reserved for settlement.

The veterinary section of the experiment station does the larger portion of its work in localities where outbreaks of disease occur, and through laboratory methods of investigation. As yet no buildings have been erected for the protection and care of experiment animals, where dangerous diseases can be safely dealt with. Small animals have been used for experiment work, but these have been confined in cages and by other extemporized methods. The erection of buildings adapted to the work of experimentation along these lines would greatly enhance the value of the work.

I append a few short articles which will serve to illustrate the line of work and the character of information given to the public through this branch of the experiment station:

INVESTIGATION OF BOVINE TUBERCULOSIS.

It is our intention to give in this bulletin, which is addressed especially to the farmers of the country, conclusions drawn from tests and experiments made at our station, as well as to present in a condensed form some additional and well established facts on the subject of tuberculosis.

The interests involved are so vast, and the adoption of wise and efficient measures are so important, the subject should receive the fullest discussion with all the available facts before us. Personal interest, and preconceived notions should not be allowed to influence our judgment. Recent discoveries and the application of new methods growing out of them, have led to the fear on the part of some that great harm is likely to be done the live stock interest. While much misleading and unprofitable discussion has been going on, science has been patiently observing facts and bringing new discoveries to light.

Some points have been effectually settled, truth has been approximated on others and yet there remains for settlement many of the practical details in dealing with the subject.

The scientific aspect of the question has made more uniform progress than the practical application of the facts discovered to the eradication of the disease. The scientist has only the difficulties of discovery to encounter. A variety of interests may be antagonized by the efforts at suppressing the disease and consequent opposition developed.

Within the last few years there has been a general awakening to the vital importance of this question all through the scientific world. The laboratories of the old world and the experiment stations of the new, are abundantly supplied with devoted students of sanitary science who are bringing every available means to bear on this question. From these diversified opportunities and fields of observation, the problem is being gradually wrought out.

Investigators working independently of one another have arrived at the same conclusions on a number of points. This method is sufficiently conclusive in its results to set at rest discussion among scientists as to the trustworthy nature of the conclusions, and to furnish an intelligent basis for restricting the evil. It may be well to summarize at least a partial list of the facts on which experimenters are so well agreed as to leave little doubt as to their accuracy. Much of the ground has been gone over by the agricultural experiment stations of the more progressive states, with remarkable uniformity as to results.

The following may be said to cover a portion of the ground that has been practically cleared from doubt.

(1) Tuberculosis of the lower animals is identical with human consumption.

(2) It is an infectious disease.

(3) The disease may be transmitted from man to the lower animals and from the lower animals to man.

(4) Tuberculosis causes more deaths in the human family than any other disease.

(5) Cows are especially susceptible to the disease, and are extensively affected by it.

(6) Milk from tuberculous cows may convey the disease to the consumer.

(7) Milk from tuberculous cows having non-affected udders may convey the disease.

(8) The flesh of tuberculous animals may convey the disease.

(9) A large proportion of the cases cannot be recognized by clinical examination.

(10) No other test yet discovered, than that afforded by tuberculin, can detect any considerable proportion of cases in the living subject, and this test is practically infallible.

(11) Injections of tuberculin cannot produce tuberculosis, nor are the results harmful.

Any one of these asseverations can be successfully defended by observations made on the part of experimenters of unquestioned credibility. Most of them have been verified in our own station work.

It is now about a year and a half since the station began the work of applying in a practical way, and on a somewhat extensive scale, the tuberculin test. The purpose has been to satisfy ourselves as to the reliability of the test, the danger, if any, resulting from its use, and, by conducting a series of tests in various parts of the state, to gather information as to the prevalence of the disease.

METHOD OF APPLYING THE TEST.

For the benefit of those not familiar with the methods of making the test, a word of explanation will be in place.

First, the temperature of every individual in the herd to be tested is carefully taken and recorded at intervals of two hours during the day preceding the test. The average of these readings will give a pretty accurate test of the individual temperature of the several animals, which is recorded as the normal, with which any variations are to be compared. Before midnight of the day on which the trial temperatures were taken, the injection of lymph is made. This consists in injecting beneath the skin, with an ordinary hypodermic syringe, two cubic centimeters of tuberculin for every thousand pounds live weight of animal. The result to be expected is a more or less well marked rise in temperature shown by all individuals affected with tuberculosis. If the animal is free from the disease, no change of temperature will result. The rise in temperature will usually begin to manifest itself in from twelve to fifteen hours after the injection is made. From four to six hours later, the temperature in those showing reaction begins to decline, and gradually reaches the normal. It is upon this variation in temperature alone that reliance is placed for determining the presence of the disease. Every possible precaution should be observed, that the conditions may be the same under which the temperature was taken, before and after the injection. Varying conditions tend to slight modification of temperature, hence the necessity for the greatest precaution, that only the change resulting from the action of the tuberculin may be shown.

If a change of one and a half or two degrees occurs, this is sufficient evidence on which to condemn the animal. A rise of four or five degrees is not unfrequently noted. There is no well authenticated evidence that these marked differences in rise of temperature shown correspond to like difference in the severity of attack.

RELIABILITY OF THE TEST.

With this feature of the subject we are especially interested. If the results obtained should not show a fair degree of uniformity under like conditions, then the test may be discarded as useless. If the test proves a means of condemning healthy animals, it is a harmful and dangerous experiment, and should be discarded at once. If diseased ones fail to respond to the test, then it is to be regarded as a means of concealing, rather than pointing out, real dangers, and is worse than useless. With these thoughts before us, the work has been done with such attention to details as would insure a fair and impartial trial.

The conditions under which we have been obliged to work have not always been such as to allow all the privileges we could have wished for, in order to obtain the fullest results. It has not always been possible to secure for slaughter all the animals showing reaction. And as a matter of course we have not had the opportunity of performing autopsies on any considerable number of those that failed to show any reaction. These are regarded as healthy and are not usually disposed of in a way to afford opportunities for post mortem. Out of eighty post mortems made on animals showing reaction, not a single case failed to give evidence of tuberculosis. And in no case where an opportunity was afforded to examine the carcass of one failing to show reaction, was the disease found to exist. In other words, the test has not failed in a single instance in our experience. Occasional failures have been noted by other experimenters. Whether this was due to lack of attention to details in the work, to want of searching methods in examining the cadaver, or to actual failure in the essential features of the test, we are not prepared to say. But it would not be a matter for surprise if there should be some contradictory results reported, owing to the many inexperienced hands into which the test has fallen. Our experience with the test, however, tallies so closely with the results obtained at other United States experiment stations, as well as scientific institutions throughout the world, that it may be said there is practically no disagreement among the workers in this field of investigation, as to the uniformity of the results. It may not be said of any drug in the pharmacopœia, that it is infallible in its action; that it was never known to produce other than its generally recognized effects, and that these invariably followed the administration. But this by no means breaks the law of uniformity or reverses the rule of action.

The New Jersey experiment station in its bulletin after detailing experiments made, summarizes its conclusions by saying, "Every case of undoubted reaction proved to be undoubtedly tuberculosis."

The Wisconsin station where careful tests have been made, publishes the results in bulletin form and gives expression to the following: "We have, then, in this agent a means of detecting the disease if we desire. The use of this agent is to be recommended."

Dr. Law in a bulletin issued from the Cornell University station speaks of tuberculin as possessing "The highest value as a test of tuberculosis in animals." He further says in the same bulletin, "This has now been employed on thousands of cows, and those who have used it most, value it most highly, whereas many who at first reported reactions in non-tuberculous animals are now acknowledging with Nocard that the fault has been mainly their own, for small tubercles were present but were overlooked through their failure to examine the bones and other organs."

The same observations have been made by workers in the Maine Agricultural College Experiment station. In the published reports of that institution we read, "With suitable instruments and professional skill it is comparatively easy for one man to examine a herd of fifty animals in less than twenty-four hours and detect every case of tuberculosis that may exist there."

The Massachusetts station, after a long and unsatisfactory attempt to rid the college herd of tuberculosis by the weeding-out process, decided to apply the tuberculin test. The bulletin of the station in speaking of the effort to free the herd from this disease without the application of the test, says, "That in all probability we should never have been able to accomplish this is shown by a study of the records of the tuberculin test." Both those that reacted and those that did not, were slaughtered, and the accuracy of the test fully demonstrated.

The North Dakota experiment station through its bulletin says: "We have taken pains to hold post mortems on all animals which have been tested up to date which yielded to the test, and in every one we have been able to demonstrate the presence of tuberculosis."

The conclusions of the Bureau of Animal Industry are thus summarized: "The number of instances in which the conditions indicated by the results of the injection do not conform to the conclusions founded on post mortem examination is so many times less the number of errors from all other methods used to diagnose tuberculosis, and there are so many cases of tuberculosis which could not possibly be detected by any other method, that even they who are least inclined to favor the use of tuberculin cannot fail to recognize its importance."

Our own station has had similar experience in dealing with the disease at home. No other means employed ever enabled us to free the college dairy herd from the disease. In every instance where post mortem proofs have been added to the findings of the tuberculin test, they have coincided. It is not necessary to multiply at length quotations from independent experimenters. They are to one and the same effect. But we have thought it worth while to present a very little of the mountain of evidence in support of this test to offset the reiterations of the objector. I have cited the most unbiased and trustworthy evidence; the observations of men employed by the government who have no occasion to become swift witnesses in support of any theory or any practice. Investigations carried on by the station authorities of Minnesota, Virginia and Arizona, the sanitary board of the Dominion of Canada and many other government stations and scientific bodies throughout the world might be drawn upon for added evidence to the proofs already furnished.

EFFECT OF TUBERCULIN ON THE HEALTH OF THE ANIMAL.

The statement has so frequently appeared in print that the use of tuberculin is harmful; that it induces tuberculosis, etc., that the results of our experience seem worthy of mention.

During the fall of 1894, ten cows that had previously reacted to tuberculin, received a second and a third injection. These animals were situated on different farms, and received the same treatment as the balance of the herd. No bad results followed in any way and in no case was the process of the disease apparently hastened.

During the spring and summer of 1895 three cows have been receiving regular injections of tuberculin. At this writing no unfavorable results have been shown.

Dr. Pearson of the Pennsylvania Experiment station says in discussing the probable danger from the use of tuberculin, "The experience of the State College Agricultural Experiment Station herd is also against this theory, because its members have now been tested with tuberculin three times. each time being injected in practically the same spot and not the slightest evil result has manifested itself, although the period of observation now extends over two and one-half years."

A bulletin issued by the experiment station of Cornell University, after detailing a series of experiments on this subject, says, "So far as there is evidence before us, everything points to the harmlessness of a single test dose on a sound animal system."

The experience of the Minnesota station furnishes conclusive proof of the same nature.

THE UNCERTAINTY OF OTHER TESTS—THE MILK TEST.

It has not been alone the purpose of the station to prove or disprove the reliability of the tuberculin test, but to compare its value as a diagnostic agent, with other means of recognizing the disease. To this end a large number of tests have been applied to cows from which samples of milk had been subjected to examination.

Much has been said through the public press in favor of this method of detecting the disease and determining the dangerous quality of the milk. Samples of milk taken from cows in charge of the experiment station, which are known to be tuberculous. were submitted to microscopic examination. These samples were declared to be free from the bacilli. This being the microscopic test of contamination there could be nothing done but to pronounce such samples free from danger as far as this test applies. However, as above stated, the cows have been proven tuberculous beyond question. Again, in ten herds, where from 5 per cent to more than 50 per cent had been pronounced tuberculous by the microscopic examination of the milk, not a single case of tuberculosis could be found by the most painstaking test. Conversely, eight cows in one herd were proven by the tuberculin test to be affected. They were slaughtered and all gave the unquestioned proof of being tuberculous These had passed the ordeal of microscopic test of milk with a clean bill of health, though two of them were found on post mortem examination to have miliary deposits throughout the udder.

These experiments have convinced us that the plan of microscopic examination of milk is altogether untrustworthy as a means of detecting the disease.

PHYSICAL EXAMINATION.

In cases where the herds were being subjected to the tuberculin test, careful physical examination of suspected and non-suspected cows have been made. These tests have proven to us that it is impossible to detect any considerable proportion of the cases in an affected herd, by the most careful examinations of this nature. Cases that have presented no evidence to the senses on which to condemn, or even to suspect the presence of disease, have reacted to the test, and post mortem examination has in many cases revealed extensive tuberculous lesions. These have been found in all parts of the body, including extensive diseased conditions of the mammary glands.

EXPERIMENTS IN FEEDING THE MILK OF TUBERCULOUS COWS.

The use of milk on experiment animals for the purpose of artifically inducing the disease in otherwise healthy individuals is a practical way of putting to the test, some of the theories as to sources of danger. If the milk from tuberculous cows, either taken in the ordinary way, or injected directly into the circulation, can induce tuberculosis, the fact becomes one of no ordinary moment. The significance of the experiment has a two-fold importance.

First —It enables us to account for many cases of the disease in young cattle. It has been shown by repeated observations that congenital infection is rare. However, calves but a few months old are frequently found to be infected.

Second.—If milk from tuberculous cows possesses infectious properties, the health and safety of the human family becomes the important part of the question. If feeding the milk to lower animals under ordinary conditions will induce the disease, there is no avoiding the conclusion that it can be induced in the human family under the same conditions. This experiment has been repeated with sufficient frequency, and under conditions to prove the certainty of results beyond question. If milk is contaminated with the bacilli of tuberculosis, it will convey the disease. But under what conditions will the milk be so contaminated, is a question for separate solution. It has been vehemently claimed that only milk from cows with udders in which the disease was localized, was to be regarded as in any sense dangerous.

An exhaustive series of experiments was undertaken by the trustees of the Massachusetts society for the promotion of agriculture, with a view of gaining light on this question. One of the experiments consisted in feeding twenty-one healthy calves on milk from tuberculous cows. At the conclusion of their experiment they report: "Of these twenty-one animals, eight, or over 33 per cent were shown to be tuberculous. That the cows from which the milk for these feeding experiments was derived were free from tuberculosis of the udder, is shown by the following table (table omitted) of their history, and the results of the post mortem examination." They draw the following conclusions:

"The possibility of milk from tuberculous udders containing the infectious elements, is undeniable."

"With the evidence here presented, it is equally undeniable that milk from diseased cows with no appreciable lesion of the udder may, and not unfrequently does, contain the bacilli of the disease."

Dr. McKenzie reports that in cases where there were no lesions of the udder, but where tubercular deposits were found in other parts of the body, the milk in 40 per cent of the cases proved to be infectious.

This is in accord with the best evidence on this subject, and especially does the extensive scientific work of Bang, of Copenhagen, coincide with these results.

Our station made experiments on three calves from tuberculous mothers. Two were allowed to take the milk from the mothers. These cows were but slightly affected, the udders to all appearances being free from disease, and no bacilli were detected in the milk when examined under the microscope. Both of these calves developed tuberculosis. A third calf from a tuberculous mother was not allowed to take the mother's milk, but was taken as soon as born and kept on the milk of a cow that had been tested and found to be healthy. This calf never showed reaction when tested with tuberculin. It was slaughtered at the age of three months, and thorough examination failed to detect any sign of disease.

This experiment tends to show that calves from tuberculous mothers are not necessarily tuberculous at birth, but that infection will take place when the udders are healthy and when there is no external evidence of disease.

ORIGIN OF THE DISEASE IN IOWA.

It is quite impossible to trace accurately the appearance of the disease in our state. We have known of its existence among our cattle for twenty-five years, and undoubtedly it traces back to a very early period in the history of our cattle industry. We first became acquainted with it in herds of well bred cattle; especially those that were represented by imported individuals. Comparatively little was known at that time of the history and real danger from the disease, and nothing of the modern methods of detection. But long before there were any laws on our statute books making provisions for control of contagious diseases, we assisted many of our breeders in their endeavors to get rid of tuberculosis by selecting out and destroying the affected individuals in their herds. The introduction of imported animals was doubtless an important factor in the introduction of the disease.

TO WHAT EXTENT DOES THE DISEASE PREVAIL IN IOWA?

The work done through this department during the last eighteen months; the occasional discovery of a seriously affected herd, and more frequently less severe outbreaks, have led to the frequent repetition of this question.

While a considerable number of tests have been made, and these in various parts of the state, we are not yet in possession of a sufficient amount of evidence on this point to furnish more than an approximation to a definite answer. The evidence of the existence of tuberculosis has been demonstrated over and over, but to attempt to deal with percentages, would be to enter the field of conjecture. It must be kept in mind that tests have been made where some form of disease was known to exist, or was believed to be present. The unsuspected herd has not, as a rule, been tested. Under these circumstances, the number of cases found to be diseased in proportion to the whole number tested, will greatly exceed the general average of cases in the state to the entire number of cattle. Again, the proportion of affected individuals in a diseased herd, varies greatly. The time during which the disease has existed, the conditions under which the animals have been kept, whether closely confined or in the open fields; these and many other conditions will have a marked influence on the degree to which the herd had been invaded. We append the figures taken at random from tested herds, that will show the extent to which the disease prevailed in these instances.

About fifty herds have been tested in the counties of Black Hawk, Kossuth, Story, Boone, Page, Harrison, Sac, Wapello and Floyd. Taking 873 animals as they occur in these herds that were subjected to the test, 122 reacted and were pronounced tuberculous. These facts give some suggestions as to the distribution of the disease, and the per cent that may be reasonably expected to react in herds that are reported for examination.

HOW THE INFECTION IS EXTENDED.

A living vegetable organism, the bacillus tuberculosis is the reproductive agent which gives rise to the disease. When this germ finds lodgement in suitable tissues, and is uninterrupted by any antiseptic agent, or opposing force, it tends to multiply with a certain degree of rapidity, and the result in the affected tissue is the deposit of tubercle. Any organ of the body may be assailed, though lymphatic and other glandular tissue, the lungs, liver and spleen are parts particularly prone to be the seat of disease. Any animal affected with the disease becomes a center of infection from which the disease may spread. Its distribution is never rapid, but a single case in a herd is certain to be followed by others in the course of time if unrestricted co-habitation is allowed. The bacilli are coughed up or expelled from the body through other channels. These may be at once conveyed to the body of a susceptible animal, or they may lie in a dried and dormant condition for months and be revived into activity when implanted in a suitable soil. Every individual going out from an affected herd becomes a menace to the animals with which it is brought in contact. Doubtless the sale of breeding stock has had more to do with the general distribution of the disease than any other one agency. A general indictment cannot be entered against the breeding stock of the state, but many of our breeders can testify to the trouble they have experienced in their endeavor to free their herds from the scourge.

INFLUENCE OF MANAGEMENT ON EXTENDING INFECTION.

The fact is admitted by investigators generally, that the character of the buildings exert a certain influence, either for or against the dissemination of the disease. It is a universally admitted fact that cattle kept in ill-ventilated, underground barns, with inadequate air space, furnish favorable conditions for increased contamination. This has been our own observation in conducting examinations on herds so situated. This fact has been emphasized to the extent that some have come to the conclusion that this cause alone furnishes practically all the explanation that is necessary to account for the disease in our herds. Not so. Bad sanitary conditions can no more originate the specific poison of tuberculosis than the virus of smallpox can be developed by the same methods. Both diseases may be aggravated and the cases multiplied by such exposure, but neither disease can be so generated. It is by no means true that extensive invasion of any given herd is to be found only when the animals are kept under such conditions. Some of the very worst outbreaks we have investigated were confined to animals that had never been kept in barns. In one herd of forty-one animals, six had died during the latter half of the summer, and ten more were found diseased by the tuberculin test. These were all slaughtered and the tubercular conditions verified by post mortem examination. This herd was at pasture, and had never been kept indoors. From another herd of twenty-eight animals five died in the course of three months. The tuberculin test found nine additional cases. These had never been kept in any better quarters than in an open plank barn. Here were two herds that led practically an out-of-door life, yet they were both rapidly dying out. The station has made abundant observations of a similar nature in other instances. If an infected individual is brought into a herd of perfectly healthy animals, it becomes a menace to the health of that herd, no matter what the conditions are under which the cattle are kept, so long as they cohabit in an unrestricted way. Let no man flatter himself that his herd is safe in the presence of a single case of tuberculosis, no matter what the extent of acres over which they may range. True, these favorable conditions will lessen the chances of infection, but they cannot remove them. Several instances have come under our observation where badly affected animals came from the best kept breeding herds in the state.

Cases that are fairly established may be hastened rather than retarded by outdoor conditions, when these mean exposure to all the inclemency of the unfavorable season. The protection of a comfortable barn, though not in the very best sanitary condition, may prolong life beyond the period that would be reached were the creature forced to fight for existence against storms and sudden changes of temperature.

WHAT ARE THE SYMPTOMS OF THE DISEASE?

This is one of the questions most frequently asked by the farmer. It is a difficult question to answer, because of the extent of detail involved in making a full statement of the case. From what has been previously said in these pages, it will be understood that almost any organ of the body may be the seat of disease. The symptoms will be correspondingly various. The pulmonary type, or that form of the disease in which the lungs are extensively affected, may be said to be the typical form. In nearly all cases where the disease is allowed to run its course, the evidence of lung affection will become apparant before death relieves the animal. This form of the disease is attended with difficult respiration, high temperature, frequent and feeble pulse, painful cough, failure of milk, emaciation, diarrhœa and finally death. Occasionally the first symptoms may be severe lameness from tubercular deposits in the articulations. Swelling and abscesses about the throat and the udder of cows, are not unfrequent manifestations. When non-vital organs are the first seat of the disease the animal may continue in a fair state of general health for months, and even years. Doubtless there are occasional cases of final permanent recovery. The disease in nearly all cases assumes a chronic type, which is misleading to the owner. But it must be accepted at once and for all, that it is impossible to detect any considerable proportion of the cases at any given time, by the most searching physical examination of the expert. If it is the fixed purpose of the owner to find the real extent of the infection in a diseased herd, he must have recourse to slaughter, or apply the tuberculin test.

RELATION OF MEAT AND MILK SUPPLY TO PUBLIC HEALTH.

That the mortality in the human family from tuberculosis exceeds the death roll from all other infectious diseases put together, is a generally admitted fact. Statistics place the death rate from this cause as high as 14 per cent. At some of our Indian agencies where the habit of eating uncooked meat is a general one, the mortality statistics show that 50 per cent of the deaths is due to tuberculosis. It is a very difficult matter to determine approximately how much of the mortality from human consumption is to be attributed directly to infection from the lower animals. The causes in most of the cases are so hidden in obscurity that a definite explanation is impossible. But there is abundance of positive proof and still more collateral evidence to show that the food supply derived from the animal kingdom is no small factor in the distribution of the disease

There are few experimenters, who have been close observers of these phenomena, who cannot cite cases that point at least in the direction of these conclusions.

One case came under our observation where five young people between the ages of twenty and thirty years died of consumption from one family during a period of two years. Not a trace of the disease had ever been known in the family of either the father or mother of the victims. On the farm where the deaths occurred we found seventeen cases of tuberculosis in the herd of cattle, and others had died before the investigation was made.

Another bit of history in connection with a diseased herd that was under test, is worthy of mention. A mother and child died; the mother from undoubted consumption; the child from intestinal trouble highly suggestive of the same disease. The cow that had supplied milk to the mother and child was tested and found to be tuberculous. Post mortem examination of the cow revealed a badly tuberculous condition of the udder. Similar observations on the part of other station workers and practicing physicians have been made so frequently that the conclusion is unavoidable that to some extent to our meat supply, and in a much larger way to our milk supply can be traced many of the cases of tuberculosis in the human family.

HOW CAN HEALTHY HERDS BE SECURED, AND HOW CAN THEY BE KEPT FREE FROM DISEASE?

This is the practical question toward which all the others tend. It is of little consequence to know that disease exists unless that knowledge can be made to aid us in averting the evils we have found. The means by which total extermination of the disease can be accomplished, do not seem to be in sight. So long as there remain cases of consumption in the human family, there remains the possibility of occasional reinfection of bovines. But the probabilities of infection from this source are remote, and should not be taken as arguments against any restrictive measures that might be adopted.

While absolute extermination of the disease at once may not be practical, we believe it to be entirely feasible to so far restrict its dangers, as to render them of slight consequence. The state has already with small expense, eradicated the disease in a considerable number of dairy herds. And what is of more value to the public at large than freeing these herds from disease, it has demonstrated the possibility and the practicability of the plan, and has done much to educate the people as to the sources of danger. The result is that many owners of herds have voluntarily, and at their own expense, had the tuberculin test applied, and the diseased animals destroyed. The work the state has done is in this way being supplemented; and the practice of testing dairy cows is likely to have a very large increase in the future, without the aid of compulsory measures. Once the herd is free from disease, it can readily be kept in this condition by exercising due precaution in the introduction of fresh stock. Dairymen who have had unfortunate experience with the disease have adopted the practice of admitting none but tested cows to their purified herds. This practice, if uniformly adopted, would very soon render the dairy herds of Iowa free from tuberculosis. If in addition to these precautions, similar vigilance were exercised over the introduction of breeding stock to the herds, the chief sources of infection could thus be shut off. If restrictive measures of this kind were applied to these two classes of cattle, practically all the cases of tuberculosis in the state would soon be found, and its ravages reduced to the minimum. The measures adopted in a few score of dairy herds in the state, if applied to the remainder, would go very far toward eradication. It is possible to reach most important practical results without the expenditure of large sums of money or the sacrifice of important interests.

All animals suffering from the disease in any of its stages should be at once removed from contact with other cattle. It is our judgment that any plan which contemplates keeping tuberculous animals on the farm, and attempting to avert danger by seggregation and other like precautoniary methods, will defeat its own ends. The less the number of possible sources of infection in the country the more successful will be the efforts at eradication. Buildings where tuberculous animals have been confined are to be regarded as infected, and no healthy animal should be assigned quarters in such enclosure till thoroughly disinfected.

It is true a single test may not in every instance free the entire herd. After-infection may take place. It would be wise in those cases where a number of badly affected animals have existed, to take the precaution of applying additional tests some months after the first. All this involves care, the expenditure of a certain amount of money, and the occasional loss of an animal. But the animal already suffering from an infectious and highly fatal disease, can not be considered to possess any high value. The inconvenience and expense attending such precautions are small in comparison with the loss and risk involved in allowing the disease to run its natural course in the herd, and the sale of dangerous products for human consumption.

HOG CHOLERA AND SWINE PLAGUE.

BY W. B. NILES.

The subject of hog cholera is such an important one to the people of Iowa that a brief article in these pages setting forth some of the main facts that have been observed in our work here, and elsewhere by others, seems warranted. While we have nothing to offer in the way of a specific cure and cannot point out the way by which the disease can be easily eradicated, a careful study of the facts herein set forth will enable the painstaking swine owner to more successfully deal with the two prevalent epizootic diseases of swine—hog cholera and swine plague.

The above named diseases are often described under the name of hog cholera, but it is now recognized by scientists that two diseases exist, due to different germs (bacteria) and presenting somewhat different symptoms. Both are widespread and may exist in the same herd, also in the same animal, at the same time. As it requires a very careful study of an outbreak of swine disease—the after-death examination of several that have died or been killed for the purpose and a bacteriological study of the blood and organs—before it can be determined whether but one or both diseases are present, it has not been definitely learned which disease is most prevalent. Our experience in this state goes to show that here, at least, the two diseases are often associated and that uncomplicated swine plague is seldom met with. The experience of the writer in another state (S. C.) points to the same conclusion. Hog cholera is probably the most prevalent and the cause of the greatest loss.

Both diseases are due to a specific virus, and communicable from one animal to another. The germ of hog cholera differs from that of swine plague by being slightly larger, having power of movement in liquids, and by developing outside the body when conditions are favorable. The virus of both diseases enters the body of the hog with food and drink, or in the inspired air.

When the disease, usually known as cholera, first appeared among Iowa hogs, is not definitely known. The probabilities are that the disease was originally imported from England and appeared in Iowa and the adjoining states in the late fifties. From this time on, outbreaks became more frequent, until in 1878, when the commissioner of agriculture appointed ten investigators to study the disease in those sections of the country where it most extensively prevailed, one was assigned to Iowa. Since that time the disease has more or less extensively prevailed every year. In 1886 the state veterinarian stated in his report that "hog cholera probably occasions more loss directly to the stock growing interests of the state than all other diseases combined."

The affection varies greatly in the extent of its ravages from year to year. In some seasons the number of outbreaks is comparatively small, while in others the loss is very great. In the past two or three years the disease has prevailed as an epizootic over a greater portion of the state. Director Sage, of the Iowa Weather and Crop Service, shows in his recent report that for the past season the loss has been 20 per cent of the entire number of hogs in the state.

The symptoms of both hog cholera and swine plague have been so often described that a detailed description of them is not necessary here. In the main the symptoms of the two affections are very much alike, and cannot be differentiated by the casual observer.

Partial or complete loss of appetite, a tendency to lie about in bunches in the nest, more or less coughing, and a purple color of the skin most marked along the abdomen and inside the thighs, are among the most prominent indications of disease noticed. In some outbreaks diarrhœa will be an early and constant symptom, while in others the reverse will be the rule. Again the disease may for some time attack only young pigs, assuming such a mild course that the true nature of the affection will not be suspected. In different outbreaks the symptoms vary so much that the most experienced may not be able to diagnose the trouble without making an after-death examination of one that has died. I wish to call especial attention to this fact, *that one herd of hogs suffering from cholera may present entirely different symptoms from another herd having the same disease.* For example: During the past summer a well qualified veterinary surgeon wrote me regarding a swine disease raging in his neighborhood which he did not diagnose as cholera, but which from his description I am satisfied was genuine cholera. Correspondence with a Nebraska farmer who had written to an agricultural paper, and had been informed in reply that his swine had indigestion or some other complaint due to improper feeding, revealed that his herd also had genuine hog cholera; for when instructed what to look for after death the characteristic changes of cholera were observed. Much has been written about "so-called cholera," and the statement is often made that "in the fall and early winter all diseases of hogs are reported as cholera." Other diseases of swine are no doubt occasionally reported as cholera, but it is my belief that such a mistake is not often made, and I wish to state emphatically that when a large per cent of a herd of swine die and apparently the same disease occurs on neighboring farms, the disease is either hog cholera or swine plague. A few other diseases may cause considerable loss in a herd, especially of young pigs, but I have yet to find an instance where a majority of even a single herd have died from another cause, and anyone having disease in his herd, involving a considerable per cent, should be suspicious of one or the other of the above mentioned diseases.

While the symptoms may be obscure, and the first attacked in the herd linger so long with a mild attack as to throw the owner off his guard, an after-death examination, especially on an animal that has been sick for some time, will reveal the presence of one or the other of the diseases under discussion. Hog cholera being principally a disease of the intestinal tract, the greatest changes are looked for there. The most characteristic occurs in the first part of the large intestine. Small, circular patches, slightly elevated above the surrounding membrane, and varying in size from a pin head to a quarter dollar, usually dark in color (sometimes of yellow cast), are found on the inner wall, near where the small gut enters. These ulcers, as they are termed by Dr. Salmon, of the bureau of animal industry, are found best developed in an animal that has been sick for several days. When the patient dies suddenly, they will not be observed.

In swine plague the chest cavity is the principal seat of the disease, and the lungs will be found inflamed and more or less adherent to the chest wall. Large portions of lung tissue are often completely hepatized (solidified), and frequently the chest cavity contains a considerable quantity of serum. As before stated, both diseases may exist in the same animal, and then the intestinal and lung changes may be seen in the same subject.

A more practical question, and one much discussed at the present time, is: "How are these diseases originated, and how communicated from place to place?" For a proper understanding of these questions, it is necessary to remember that both affections are communicable and due to a specific germ, without which the disease will not exist. Being due to a specific virus, spontaneous origin is impossible, just as is the case of glanders in the horse or smallpox in man. No system of feeding, or exposure to bad sanitary conditions, or any other sort of treatment, will originate, without the presence of the specific germ, any communicable disease of man or beast.

Remembering that the presence of the virus is essential to the production of an outbreak of cholera, it will be readily understood that the diseased animal is the most dangerous source of infection. A careful study of cholera outbreaks shows that very many of them can be easily traced to animals that have been purchased and brought into the herd while sick, or after having been exposed to the disease, or to wandering animals from adjoining farms. Two years ago outbreaks were started in many sections of the state by shipping in stock hogs from Nebraska. Many of these Nebraska hogs had been exposed before shipment, and consequently became conveyors of the disease wherever they were taken. It is true that there are many other ways by which the germ may be carried, for example, by beasts of prey, carrion birds, streams of water, feet of attendants in muddy weather, etc., but the living diseased or exposed animal must always be regarded as the most dangerous of all.

Recognizing that the disease has its origin in a specific germ which was probably imported from England, and is kept alive by herds in different sections of the country, and that the disease spreads by being communicated from diseased herds to those unaffected, the question arises as to what part may be played by secondary causes? At the present time some writers contend that while the presence of the germ may be essential in the production of an attack, it cannot alone produce disease; that it must be assisted by other causes. The same ground has been taken regarding cholera in man and tuberculosis in cattle. The writers referred to contend that as the greatest loss prevails in the corn growing belt, the almost exclusive corn diet is the necessary assisting factor in producing the disease, and that if a mixed diet were fed, the disease would be much less prevalent. Others contend that as the outbreaks usually occur at that season of the year when new corn is being fed that the green corn is actually the cause of the disease; others think that our improved breeds of swine have such a low resisting power that they contract the disease when the bacon breeds would escape. Let us notice these theories briefly.

First—Is the hog cholera germ alone capable of producing disease without the aid of other causes? After a study of many outbreaks affecting different breeds kept under different conditions, I am firmly of the opinion that virulent cholera virus will produce an outbreak of cholera without the action of secondary causes. It is true that there is some difference in the susceptibility of animals to the plague, and also a difference in the virulency of the germ from different outbreaks. No breed of swine, however, can be considered exempt from cholera. I have seen the celebrated razor-back on his native heath die as rapidly as our most improved breeds in the north. The celebrated bacon breeds also readily contract the disease when exposed, as was shown the past season at the experiment station. I am satisfied that the greatest loss occurs in the corn belt, principally because more hogs are kept and the chances of communication are better. The keeping of an animal in vigorous health by observing the proper rules of sanitation and feeding, will render it to a certain extent less liable to any disease, but such care will not grant immunity against our swine epizootics. I have stated that in some instances the germ is more virulent than at other times. This, and the difference in susceptibility that animals may possess, probably accounts for the mildness of some outbreaks and the virulency of others. When a herd having great resisting powers is exposed to virus from a mild outbreak, a mild form of cholera will result, and vice versa. There are probably several factors which may influence the severity of an outbreak. The condition of the soil, temperature and amount of moisture present, no doubt play important roles. Again, a mixed outbreak of the two affections may be more severe than an attack of hog cholera or swine plague alone. Bad sanitation I consider renders more assistance in the spreading of cholera than all other secondary causes. This does not act so much, as some suppose, by weakening the animal, as by rendering the development and transportation of the germ easy.

The theory that the disease is caused by feeding new corn has nothing to support it except that the disease is usually prevalent in early fall when new corn is being fed. There is no connection between the two. It happens to be the case that in the fall of the year the climatic conditions are favorable for the development of the hog cholera bacillus. At the same time in the year the corn crop is maturing and farmers begin to feed it. In the human family typhoid fever most often occurs in the fall of the year, but the physician does not attribute it to any particular diet people may eat at that time. The fact is that hog cholera and typhoid fever are very similar diseases and always rage most extensively in late summer and fall because conditions outside of the body are then most favorable for the development of the virus. New corn may produce indigestion (very seldom does however) but never cholera. We may leave this part of the subject by repeating that our swine epizootics are specific diseases caused by living germs, and that while there are secondary causes that may increase the susceptibility to disease and assist in spreading the contagion, none of them will cause an outbreak without the germ. On the other hand the virus may be sufficiently virulent to cause a fatal outbreak in the most vigorous well cared for herd. The last is also true of other animal diseases, and he who would protect live stock against infectious and contagious diseases by other means than by excluding the virus, makes a fatal error.

The most practical question of all is: What shall or can be done to prevent the great loss which occurs yearly. For twenty years the disease has been very prevalent and for more than ten years the cause has been known and sanitary measures recommended, calculated to arrest the spread of the trouble, and yet the disease is as prevalent as ever. Practically no progress has been made so far in dealing with it. Must the great loss continue, or will a cure or preventive be discovered? Can the plague be stamped out by the application of the vigorous measures recommended by some, or how can it best be dealt with? These are important questions and ones not easily answered. Much might be written regarding the use of drugs. For years we have frequently heard that this one and that one had a cure for the disease. The past season these "cures" have been more numerous than ever, and yet not one of these compounds has stood the test when applied to the treatment of different outbreaks of the disease. I have already explained that the disease may be mild or severe, and that in some herds a majority recover without treatment. This difference in virulency makes much difference in the apparent results of treatment, so that if a medicine be used in a mild outbreak, recovery may be the rule, while if used in a very virulent outbreak, all may die.

In view of these facts I unhesitatingly say that whatever reputation has been gained by any one of the cholera compounds, has been obtained by its being used when the disease was mild or when the animal would have recovered without any treatment. I have heard breeders state that after trying a preparation two years in succession with apparent good results, it utterly failed the third year.

The preparation tried and recommended by the Bureau of Animal Industry acts in a similar way to other cholera mixtures. It appears to do good in some herds; in others it is of no merit. When tried on the agricultural college herd it was of no apparent benefit, either as a preventive or curative agent. It is not reasonable to suppose, in my opinion, that any drug or combination of drugs will prove a specific for hog cholera. There is no specific for typhoid fever and cholera in man, nor other diseases of a like nature. While I have no faith whatever in the successful treatment of virulent hog cholera or swine plague, I do not wish to be understood as discouraging the use of drugs altogether in the management of these affections, for no doubt recovery can be assisted in mild attacks by proper medication. The practicability of treatment even in these cases may be questioned, for the cost of medicine and time spent in administering is often in excess of the benefit derived, and unless the herd be so situated that medication can be carried out without great expense and bother, the administration of no drug whatever is advisable. A purgative at the outset of the disease, followed by some antiseptic like carbolic acid or hyposulphite of soda, will give as good results as anything.

Since it is becoming more generally understood that treatment is of little avail, more attention is being paid to preventive measures. A number of years ago Doctor Billings, then of the Nebraska Experiment station, announced with much positiveness that he could prevent the disease by inoculation. I deem it necessary to refer briefly to this subject, as Doctor Detmers and one or two others during the past season have quite extensively advertised for herds of inoculate, contending that their method was a success. Inoculation for the prevention of hog cholera, tried by the bureau of animal industry, at an early day, and practiced later by Billings, Detmers and others, consists of injecting beneath the skin of the animal to be protected a small amount of an artificial culture of hog cholera bacteria. The culture is obtained by inoculating beef broth with blood from a cholera hog. In other words, the hog is inoculated with a small amount of hog cholera virus—an amount supposed to be so small and attenuated in virulence that sufficient disturbance will be set up in the body to render the animal immune, but not to cause cholera.

A study of the work along this line shows that very different results follow the inoculation of different herds. A variable per cent of animals inoculated are protected against cholera. Some continue susceptible and contract the disease when exposed, and others contract cholera as the result of the inoculation. The results of inoculation made during the past season are far from satisfactory, and the fact that the disease may be started by this method of inoculation where it did not exist before, renders prevention by this means somewhat hazardous, to say the least. Even if this dangerous factor could be eliminated, I do not believe a large enough per cent are protected to render inoculation of much value.

A few years ago the chemist of the Bureau of Animal Industry announced that the blood serum of small animals which had been artificially rendered immune against cholera, could be used to render other animals immune More recently, Dr. Peters, of the Nebraska Experiment station, who has recently begun work along this line, announces that by repeatedly inoculating the horse with a virulent hog cholera culture, it can be rendered so immune that its blood serum can be used to protect swine against cholera. This is another application of the serum therapy treatment of disease.

While it has shown that immunity can, in some cases, be produced in this way, a sufficient amount of work has not yet been done to determine the degree of success and practicability of the method. In the serum therapy treatment proper there is no danger of starting an outbreak of disease, as no hog cholera bacteria are injected, as is the case when inoculation, according to the method of Billings or Detmers is practiced, and if a sufficient degree of immunity can be produced to protect, the method will have much to recommend it. In a late paper, however, it is announced that this method is more successful when a small amount of cholera virus is used along with the serum, a combining of serum therapy with inoculation. It would seem to the writer that the use of a virulent virus along with the serum, complicates the treatment and renders it open to some of the objections brought against inoculation as practiced by Billings and others. It is also the opinion of the writer that if the loss is to be prevented by the use of a therapeutic serum that two serums will be necessary, one for hog cholera and one for swine plague. This also applies to inoculation

Should the serum therapy treament prove practicable, it will be of much service in preventing the ravages of swine diseases, but sanitary rules and regulations must continue to offer the best solution of the trouble. There can be no question but what if a well organized system of sanitary science and police could be put in force, our swine epizootics would soon cease to cause serious loss. While it may not be possible to completely stamp out these diseases on account of the great extent of territory involved, and the length of time that the virus lingers about the premises, the loss can be so much reduced as to be of little moment. Such efficient regulations cannot be put in

force by swine raisers, but must come from the general government or state, and in the main would consist of destroying some herds, quarantining others, and of a thorough supervision of all swine traffic.

The writer is firmly of the opinion that much more should be done by the swine owners themselves than is being done. One of the very essential things in resisting the ravages of the affections under discussion, is for the people to accept the findings of investigators and try to put into effect the advice given, instead of giving heed to the theories of those who have no knowledge of animal diseases, as many are inclined to do.

As already indicated, the most essential preventive measure is the excluding of all sources of contagion. To accomplish this result, it is very necessary that all swine bought for breeding or feeding purposes, should be quarantined for at least thirty days before being placed with the herd, and that the water supply be carefully looked after. Water from deep wells is always preferable; that from streams and surface wells may become polluted with cholera germs. The herd most completely shut off from the outside world during cholera times, is the one most liable to escape.

After the disease appears, something can be accomplished by separating the herd into small bunches kept some distance apart, by cremating the dead, and by disinfecting the yards and pens by the free use of lime or crude carbolic acid. If the farm is re-stocked with swine, new yards should be provided

For ten years or more the true cause of cholera has been known and the proper rules and regulations for its suppression recommended; but instead of following the advice given, many have given prominence to such supposed causes as the feeding of new corn, breed of swine, worms, and others, which have been much discussed to the exclusion of the real issue. If every swine raiser would remember the main facts, viz: that the disease is communicable, occurring only as the result of the presence of the cholera or swine plague germ; that the sick or exposed hog is the usual carrier of the virus, that the disease is incurable, and would then do the best he can to exercise the necessary precautions to prevent disease reaching his premises, the great annual loss would be very greatly reduced. Such work on the part of swine owners in co-operation with sanitary police work on the part of the government, would soon place us in a position where the epizootic diseases of swine would give us little trouble.

REPORT OF CHEMICAL SECTION.

J. B. WEEMS IN CHARGE.

I have the honor of presenting the following report for the chemical section for the biennial period of 1895-1896, 1896-1897:

The work of the section has been largely of the nature of investigations upon various subjects, among which may be included the following: Analysis and examination of substances used for adulteration of butter and cheese; the native grasses of the state, in connection with the botanical section; soil moisture, in connection with the agricultural section, and the investigation on the chemical composition of sugar beets now in progress.

A large amount of analytical work has been carried on for the other sections of the station, and for others where the object was of such nature that it could be considered to be of public interest.

The equipment of the section has been increased as may be seen when comparison is made between the inventory of 1895 and 1897. These additions to the equipment of the section will enable to carry out most of its work without the hindrances due to lack of proper equipment.

	Nov. 1, 1895.	Nov. 1, 1897
Value of chemicals	$ 148 93	$ 229.34
Value of apparatus	1,536.81	2,555 55
Value of office furniture	81.25	186.15
Total value	$ 1,766 99	$ 2,971.04

FINANCIAL STATEMENT IOWA AGRICULTURAL COLLEGE EXPERIMENT STATION IN ACCOUNT WITH THE UNITED STATES APPROPRIATION

DEBITS.

To receipts from the treasurer of the United States as per appropriation for fiscal year ending June 30, 1896, as per act of congress approved March 2, 1887		$ 15,000.00

CREDITS.

Salaries	$ 7,240 26	
Labor	1.387.99	
Publications	1,962 44	
Postage and stationery	413 67	
Freight and express	532 67	
Heat, light and water	483 68	
Chemical supplies	506 48	
Seeds, plants and sundry supplies	1,134 43	
Library	21 23	
Tools, implements and machinery	227.40	
Furniture and fixtures	305.20	
Scientific apparatus	33.35	
Traveling expenses	338.66	
Contingent expenses	16 40	
Building and repairs	396.14	
Total		$ 15,000.00

We, the undersigned duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the treasurer of the Iowa Agricultural College Experiment station for the fiscal year ending June 30, 1896; that we have found the same well kept and classified as above, and that the receipts for the year from the treasurer of the United States are shown to have been $15,000, and the corresponding disbursements $15,000, for all of which proper vouchers are on file and have been by us examined and found correct.

And we further certify, that the expenditures have been solely for the purposes set forth in the act of congress approved March 2, 1887.

(Signed)

W. M. BEARDSHEAR,
[SEAL.] E. W. STANTON,
Auditors.

Attest:
W. M. BEARDSHEAR,
Custodian.

IOWA ARGRICULTURAL COLLEGE EXPERIMENT STATION IN ACCOUNT WITH THE UNITED STATES APPROPRIATION,

DEBITS.

To receipts from the treasurer of the United States as per appropriation for fiscal year ending June 30, 1897, as per act of congress approved March 2, 1887		$ 15,000 00

CREDITS.

Salaries	$ 6.681.16	
Labor	2,210.36	
Publications	846.27	
Postage and stationery	459.43	

Freight and express	$ 562.06	
Heat, light and water	591.34	
Chemical supplies	266.30	
Seeds, plants and sundry supplies	1,000.08	
Feeding stuffs	622.17	
Library	11.99	
Tools, implements and machinery	395 44	
Furniture and fixtures	40 90	
Scientific apparatus	109 94	
Live stock	346 01	
Traveling expenses	398.92	
Contingent expenses	30 00	
Building and repairs	427.58	
Total		$ 15,000.00

We, the undersigned duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the treasurer of the Iowa Agricultural College Experiment station for the fiscal year ending June 30, 1897; that we have found the same well kept and classified as above, and that the receipts for the year from the treasurer of th United States are shown to have been $15,000, and the corresponding disbursements $15,000; for all of which proper vouchers are on file and have been by us examined and found correct.

And we further certify that the expenditures have been solely for the purposes set forth in the act of congress approved March 2, 1887.

(Signed)

W. M. BEARDSHEAR,
[SEAL.] E. W. STANTON,
Auditors.

Attest:
W. M. BEARDSHEAR,
Custodian.

It should be noted that the foregoing statement of the receipts and expenditures of the experiment station for the two years ending June 30, 1897, covers the fiscal years of the national government, and that these do not correspond with those of the college. This fact renders, of course, any comparison of the accounts in this statement with those in the reports of the treasurer and secretary impracticable.

HERMAN KNAPP,
Treasurer of Station.

HORTICULTURE AND FORESTRY.

J. L. BUDD, PROFESSOR.

CLASS ROOM WORK.

Instruction in horticulture and forestry is confined mainly to the students of the agricultural course. But at all times we have some special students and it is an optional study in the ladies' course. In 1896, the freshman class numbered thirteen, the sophomore class twenty-four, the junior class twenty, and the senior class ten. In 1897, the freshman class numbered eighteen, the sophomore class twenty, the junior class eleven and the senior class eleven.

As in recent years no text-books are used except in the way of reference to books in the library. The system of lectures and note taking with questions on the preceding lesson, discussions, and the use of class room and field illustrations, have given best results in fitting students for positions in agricultural colleges and experiment stations, for nursery and orchard managers, and for the right kind of home development.

INFLUENCE OF EXPERIMENTAL WORK.

In the report of the experiment station on a prior page some notes are given on the experiments in horticulture and forestry during the past twenty-one years. In this connection it is well to state that the extended work there outlined briefly has added materially in fitting students for their life work. Our young men who have gone out as leaders in horticulture, and professors in agricultural colleges, have been usually successful, growing largely out of their joining theory with practice. In other words the details of all work in garden, nursery and orchards are quite as important as the class room instruction.

While the present extended distribution of trees to trial stations will be discontinued after the spring of 1898, the work in all lines will be continued on a smaller scale quite as useful for student drill and development.

THE GREENHOUSE.

In the biennial report of 1895, the writer stated, "As yet our station has no facilities for certain lines of experimental work under glass." With the advances in other lines of work of the experiment station we need room in the new greenhouse for valuable work in horticulture and agriculture, botany and entomology, and agricultural chemistry. If durably constructed of iron, slate and glass, the erection and heating of the building will cost not less than $12,000

The appropriation secured was only $5,000. With this amount Professor Trelease, of Shaw's garden, of St. Louis, has said we have the best, most durable and neatest structure for the amount expended that he has inspected. The palm house and room for specimen plants will answer fairly well, but are too small. The serious shortage is in the way of low structures for propagation and the practical work of the different divisions of the station as outlined in the plan submitted two years ago..

With an additional appropriation of $35,000 for rose house and three extensions fifty feet long for the practical uses named our facilities would compare favorably with those of other leading agricultural colleges.

VETERINARY SCIENCE.

M. STALKER, PROFESSOR.

When congress provided for the establishment of agricultural colleges in the several states, it evidently did so in view of the fact that certain lines of education were not maintained throughout the country with the degree of thoroughness that ought to exist. Up to the time of this provision, no branch of industrial education had suffered more from neglect, or was in a more hopeless state of empiricism than veterinary science. At the time of the passage of this act there was not in the United States a single institution that was entitled to the claim of being a veterinary college, measured by the standard of judging such organizations at the present time. The Iowa Agricultural College was one of the first to take steps in this direction, and finally to adopt a course of study and invite students to its privileges. A faculty was organized, and a curriculum adopted. The management soon saw the necessity for a graded course of work, longer terms of study and more facilities than were contemplated in the first inception of the idea. A three years' course of study was adopted, models and general museum materials were collected for purposes of illustration, a commodious infirmary was erected, lecture rooms and laboratories were provided, and the whole equipment organized into a school of medicine of the veterinary specialty. The idea was new to young men looking for college advantages, and was regarded with some degree of suspicion, as savoring of the novel and unreliable.

Gradually a limited number of students became interested, completed the course and entered on professional careers. The results in a majority of cases were satisfactory, and gratifying numbers were enrolled for the course. The prosperous years of live stock husbandry were favorable opportunities, and the young graduate was in active demand. Everything went well until the almost unprecedented decline in horse values; and to some extent the same was true of other live stock property, when the services of the practicing veterinarian were less in demand. Such a state of affairs tended to discourage students from entering on a profession which was not so full of promise as formerly. The natural result was a decline in attendance. Meanwhile, the general government began to want specialists in this line for the prosecution of its work. Some years before it had provided means for education along industrial lines. Now this same government naturally looked for results, and for such specialists as its work demanded. The results were, that there proved to be an active demand for bright, well-trained young men to enter the bureau of animal industry to engage in its various lines of work. Colleges and experiment stations were looking for educated veterinarians to take charge of their departments, and it was soon found that there were places for all qualified men who cared to give up the regular practice of the profession for federal, state, and scientific situations. All this has brought about a reaction, and now young men with fair educational preparation are actively interesting themselves in veterinary studies.

The college is well provided with facilities for its work in most lines, but there are certain additions which should be made to its present equipment. An additional building should be erected to contain an operating room and dissecting room. This should be erected in close proximity to the hospital, where all cases would be taken for surgical operations, and a separate floor should be fitted with cold storage and other facilities for a dissecting room that could be made available at any time during the summer months. Such a building could be erected and the necessary changes made in the present hospital for an amount not to exceed $6,000 or $7,000. This would place the department in excellent condition for conducting all its lines of work in a satisfactory manner.

A scheme of the course of study is presented, which will give a general notion of the line of work engaged in.

COURSE OF INSTRUCTION.

FRESHMAN YEAR.

FIRST TERM.	SECOND TERM.
Anatomy of Domestic Animals—5	Anatomy of Domestic Animals—5
Dissection and Clinics—5	Elementary Botany—2
English Language—5	Dissection and Clinics—5
Histology—2	Veterinary Medicine—5
Principles of Heredity—2	Physiology—4
Military Drill—2	Zoology—2
	Military Drill—2
	Library Work—1

JUNIOR YEAR.

FIRST TERM.	SECOND TERM.
Botany, Pharmaceutical—1	Anatomy of Domestic Animals—3
Chemistry, General—3	Chemistry—3
Dissection and Clinics—5	Clinics—5
Materia Medica—5	Veterinary Medicine—5
Physiology—3	Ophthalmology—1
Zoology—2	Pathology, General—3
Military Drill—2	Animal Parasites—2
	Military Drill—2

SENIOR YEAR.

FIRST TERM.	SECOND TERM.
Botany, Bacteriology—1	Anatomy of Domestic Animals—3
Chemistry—3	Veterinary Surgery, Principles and Practice of—3
Pathology, Comparative—3	Obstetrics—3
Therapeutics—2	Ophthalmology—1
Veterinary Medicine, Principles and Practice of—5	Clinics—5
Operative Surgery, Principles of—3	Therapeutics, Surgical—2
Milk and Meat Inspection—2	Examination for Soundness—2
Clinics—5	Shoeing, Principles of—1
Thesis begun.	Animal Nutrition—5
	Thesis, finished four weeks before close of term.

BIENNIAL REPORT OF THE DEPARTMENT OF MECHANICAL ENGINEERING.

G. W. BISSELL, PROFESSOR.

At the beginning of the biennial period there was appropriated to the college, for the purpose of shops, the sum of $5,000. Said amount has been expended in the building and permanent fixtures of a combined forge shop and foundry. The building is 77 feet long by 33 feet wide, the walls being 16 feet high from the floor to the eaves. Seventeen large windows and doors, together with a skylight, give abundance of light and ready access to the interior of the building. A chimney 32 feet high, of brick, was built for the brass furnace and core oven. The roof is of slate, on sheathing, and is supported by a substantial steel truss construction designed with special reference to the needs of such a building. Steam heating is provided, the supply being taken from the adjoining power house of the college. The stationary equipment provided from this appropriation consists of an improved cupola and accessories for the melting of iron; a brass furnace and core oven of brick, with iron trimmings; a system of line shafting, from which are driven the various tools for the operation of the shop; a complete system of blast pipes for the forges, and an exhaust fan for the carrying off of the smoke and dust from the forges and the foundry work. A traveling crane, the ways for which are supported by the roof, constitutes also a portion of the equipment. The other items of equipment necessary for the work are supplied from other funds. The building is very complete and well adapted to the work, and meets very satisfactorily the demands which we have had for a long time for suitable facilities for this work. I would respectfully urge the attention of the general assembly to the needs of the department in the direction of a carpenter shop for that department of our manual training. This department is now housed in a dilapidated building heated by stoves, which, besides being entirely unsuited to our work, is in addition a serious menace to the safety of the other buildings, by which it is closely surrounded, on account of the immense fire risk involved by the presence of such an inflammable structure. The sum of $10,000 is none too much to be expended in the construction of a new building for this work, and it is hoped this matter may receive serious consideration by those who are interested in industrial and technical education in Iowa.

CIVIL ENGINEERING.

A. MARSTON, PROFESSOR.

During the past biennial period considerable repair work has been done to the rooms occupied by this department. The laboratory equipment has been increased by the purchase of apparatus for conducting all the standard tests of building stones and paving brick, and, in conjunction with the mechanical engineering department, of a 100,000 pounds automatic and autographic Riehle's testing machine. It is believed that some progress also, has been made in the work of the department, which it is intended continually to improve, and keep abreast of the times. For example, the increased laboratory equipment affords better facilities for laboratory and experimental work, the results of which can be noticed especially in the quality of the thesis work.

During the biennial period interesting tests of Iowa building stones and paving bricks have been made, which it is hoped to extend in the future, and a thesis on another subject won the Engineering News thesis prize for 1895 in a competition open to all the engineering schools of the country.

The department at present occupies the third story of Engineering hall. Its rooms include a large class room, large drafting room, the office, and the instrument room. The department is well supplied with instruments for ordinary field work, including six transits, four levels, two compasses, a plane table, etc. Its laboratory equipment, in addition to what has already been mentioned, includes a complete cement testing outfit.

The most pressing needs of the department at present are for more space and greater laboratory equipment. We are now wholly dependent upon the courtesy of the overcrowded mechanical engineering department for space to place our present laboratory equipment, and this equipment should be at once increased by fitting up an hydraulic laboratory, and by adding much additional testing apparatus. The only adequate solution of the matter will be to erect a large, well-built and handsome engineering hall, to cost say $75,000 to $100,000, to serve as headquarters for all the engineering departments. The present building could then be devoted to laboratories and shops, filling a pressing want. It is earnestly to be hoped that the time may soon come when this can be done, and when the work of the department can be extended and improved in various lines along which we can at present only slowly progress.

During the biennial period now closing the department has prepared the detailed plans for the college waterworks, including those of the elevated steel tank, the largest in the west. It is a source of pride that these plans, both originated and fully worked out by the department, were completely approved by the competent consulting engineers to whom, by request of the department, they were submitted before construction. The construction of the system was carefully supervised by the department, the supervision being probably more minute and rigid than any other system ever constructed in this state has received.

Much other work has also been supervised for the college by the department, and in all such work student assistance has been used whenever needed and suitable. Such work constitutes a valuable drill for the students who do it.

DEPARTMENT OF PHYSICS AND ELECTRICAL ENGINEERING.

L. B. SPINNEY, PROFESSOR.

This period has been for the department a prosperous one. The facilities for carrying on the work have been materially increased by the completion of the system of switch-boards and electric connections which extend to all laboratory rooms, the assembling of dynamos and motors in the dynamo room, and the equipment of the cottage basement rooms for special work. The class work has shown a growth corresponding.

The department offers the following courses:

1. Mechanics and heat, five hours per week. Spring term.
2. Light and sound, three hours per week. Spring term.
3. General astronomy, five hours per week. Fall term.
4. Spherical and practical astronomy, three hours per week. Fall term.
5. Theory and practice of photography, one lecture and one afternoon per week. Fall term.
6. Elementary mechanics and heat, five hours spring term and three hours fall term. (For engineers.)
7. Electricity and magnetism, five hours per week. Fall term.
8. Dynamo electric machinery, four hours per week. Spring term.
9. Applied electricity, four hours per week. Fall term.
10. General physical laboratory, two afternoons per week. Spring or fall term.
11. Physical laboratory, elementary electrical measurements, two afternoons per week. Spring or fall term.
12. Physical laboratory, electrical testing, two afternoons per week. Spring or fall term.
13. Physical laboratory, dynamo and motor and commercial plant testing, two afternoons per week. Fall term.
14. Electric light wiring, one lecture per week. Fall term.
15. Electrical designing, batteries, ammeters, voltmeters, etc., one afternoon per week. Spring term.
16. Electrical designing, dynamos, motors, etc., two afternoons per week. Fall term.
17. Theses in physics and electrical engineering.

Of the above courses, 1 to 9 inclusive are in lecture and recitation work, and 10 to 17, excepting 14, are laboratory courses.

The department is in need of better lecture room and laboratory facilities. Improvements in the present lecture room are now under consideration which will help in this direction, but a well appointed physical lecture room, such as can only be provided for in the original plans of a building, is very much needed.

Nearly all of the senior work in the physical laboratory and a very large part of the junior work requires basement rooms or first-floor rooms provided with heavy stone piers for supporting instruments. A great deal of physical laboratory work is impossible in second story rooms.

The apparatus of the department is necessarily more or less exposed to the fumes from the chemical laboratory below, thereby suffering deterioration.

The department should have new quarters in the basement and on the first floor of a building separate from the chemical laboratory. A further urgent need of the department is an astronomical observatory. Course four would be far more helpful to the student and much more "practical" if astronomical instruments were at hand for demonstration purposes. Course three could also be made more instructive if the student had access to some of the more simple instruments.

MINING ENGINEERING.

JAMES RUSH LINCOLN, PROFESSOR.

I have the honor to report as follows for the various classes I instruct:

The mining engineering class of next year will require quarters for class and laboratory work, or it will be impossible to accomplish satisfactory results. Good work cannot he done without proper equipment, and proper rooms in which the work can be done, without the interference resulting from the use of the same quarters by classes in various courses of study.

If an armory is erected the mining engineering department can be associated with the department of military science and tactics to the advantage of each, and this will also vacate rooms for the use of other departments.

A generous appropriation can be used to the great advantage of this course which is now in its infancy and with a small equipment.

The class in commercial law accomplished good work and with the usual interest in this study. The classes in book-keeping were enabled with their new tables to work with increased interest and accomplished good results.

DEPARTMENT OF BOTANY.

L. H. PAMMEL, PROFESSOR.

In making my biennial report for the years 1896 and 1897 I desire to give a brief history of the department since its inception. In this way we get a better idea of what has been accomplished and whether the funds committed to its charge have been wisely used.

Dr. A. S. Welch in his first report, made on the 10th of January, 1870, recommended among other things that a chair of botany and horticulture be filled. During the first college year botany was taught by the lamented Dr. Townsend. In 1871 provision was made for the instruction of botany by the election of Prof. Charles E. Bessey, a graduate of the Michigan Agricultural college, as an instructor at a salary of $1,250 a year. In addition to his work in botany, zoology, entomology, and physiology were taught, besides having charge of the vegetable garden. Considerable activity was shown; the herbarium was increased to 2,500 species of plants. He also published a paper: "Contributions to the Flora of Iowa"; in this work he was assisted by Prof. J. C. Arthur, then a member of the junior class.

In 1873 Professor Bessey still covered the entire field of natural history. The herbarium increased to 3,600 species. In 1877 Dr. J. C. Arthur was added to the list of instructors and Professor Bessey had charge of the department of biology. The herbarium was increased to 5,000 species. A botanical laboratory was fitted up on the second floor of the main building to accommodate ten students. Each table was provided with one compound microscope. It will be seen from this that laboratory instruction was deemed of great importance. Research work, so essential to keep in touch with the spirit of progress, was early appreciated. A paper on blights (*Erysiphea*) was published.

In 1879 the scope of botanical work was extended so that vegetable physiology, anatomy, and cryptogamic botany found a more prominent place in the curriculum. The facilities for instruction also increased; the department owned eleven microscopes. In 1880–1881 the department was moved from its cramped quarters in the main building to what was known as North hall. Here the botanical department was domiciled till 1894. The building was not desirable for the purpose, but it was better than that to which the department had been accustomed. The building was prôvided with a large lecture room, a laboratory, a herbarium room, and an office. In 1882 it passed through a cyclone which destroyed the southeast wing containing the herbarium.

In 1894 the department occupied temporary quarters in the new Agricultural building. In 1896 it moved to the main building, where excellent light for laboratories, a lecture room and offices, besides plenty of store room were provided.

Much time was spent by Professor Bessey in the lecture room and laboratory. requiring on an average three hours a day. The collection had increased to 7,000 species of plants, and with the apparatus was valued at $2,562.75. In 1882 the annual increase of 3,500 specimens was noted. The collection was arranged by Dr. J. C Arthur. In 1883 the herbarium was increased by 1,620 species. In addition to teaching, much time was spent by Dr. Bessey in labeling and mounting specimens.

In the spring of 1885 Dr. Bessey was called to the chair of botany in the Uuiversity of Nebraska at a much increased salary. All of the earlier students of the college appreciated his untiring efforts to build up the department, His enthusiasm kindled in his students a desire to work along the lines suggested by him. Of the students who owe their early zeal in natural history work to him mention can be made of Dr. J. C. Arthur, Purdue University, Lafayette, Ind.; Prof. Herbert Osborn, Iowa Agricultural College; Prof. F. L. Harvey; Orono, Me.; Prof. E. S. Richman, California; C. L. Suksdorf, Buffalo, N. Y., Prof. A. S. Hitchcock, Manhattan, Kan.; besides a score of others who have entered the allied sciences of agriculture and horticulture.

Dr. Bessey made for the college a reputation as a recognized authority along certain lines. His text-book on botany was widely used, and besides his editorial connection with the American Naturalist he was the author of numerous papers. His work has been of inestimable value to the college and state.

In 1885, Dr. Byron D. Halsted, a graduate of the Michigan Agricultural College and Howard University, and editor of the American Agriculturist, was called to the chair of botany. During the year 4,000 specimens were added to the herbarium. Dr. Halsted resigned to accept a better position in Rutger's college, New Brunswick, N. J., in January, 1889. During his connection with the College two scientific bulletins were published, one in 1886 and one in 1888.

In addition to these papers, much other matter appeared from his pen in scientific and agricultural papers. Several of Dr. Halsted's students have since done excellent work; Prof. S. A. Beach, Geneva, N. Y ; Prof. P. H. Rolfs, Lake City, Fla.; Prof. J. A. Kelsey, Rutger's college, New Brunswick, N. J.

In 1889 the present writer was called to the chair. Few changes were made in the curriculum; bacteriology was added to the course, at first for veterinary students, and in 1890 for students in the course for ladies and the sciences. The courses in vegetable physiology and cryptogamic botany were rearranged by placing them earlier in the course. In 1891, owing to the Morrill support fund, it was possible to extend the work of the department, and Prof. P. H. Rolfs was made an assistant. He served in this capacity until called to the chair of biology in the Florida Agricultural College. The herbarium was increased by donations from Professor Rolfs and Mr. Ferd. Reppert, and the private collection of the writer, amounting to 7,000 specimens, was donated to the college. There were also donations from the United States department of agriculture, and a valuable collection of Iowa plants from A. S. Hitchcock.

During this biennial period, Dr. Mary A. Nichols, a graduate student, and Mr. F. C. Stewart acted as assistants. Mr. Stewart, who served as assistant for three years, received an appointment as mycologist to the New York Agricultural Experiment Station at Jamaica. In 1895, Mr. C. B. Weaver and Miss Emma Sirrine and Prof. G. W. Carver acted as assistants. Professor Carver was called to an important position in the well known colored institute at Tuskeegee, Ala.

In 1895 the college purchased the Parry herbarium, a valuable acquisition. It contains hundreds of types from the West and Southwest. Dr. Parry was connected with many of the government surveys. The herbarium has been largely increased by donation, some 5,000 specimens having been added in 1897. The gifts came from R. I. Cratty, Armstrong, Iowa; Iowa State University; Henry Eggert, East St. Louis, Mo.; Prof. C. S. Crandall, Fort Collins, Col.; Prof. Aven Nelson, Laramie, Wyo.; United States Department of Agriculture; Barnes and Miller, Blue Grass, Iowa; F. Lamson-Scribner, Washington, D.C.; Columbia College, New York; Field Columbian Museum, Chicago; and Prof. P. H. Rolfs, Lake City, Fla. Some minor purchases have also been made; these were mostly fungi.

During the past year two graduate students, Mr. C. R. Ball and Mr. Robert Combs, have assisted the department in instruction and in working up the state flora.

At the end of twenty-seven years, the college collection contains 70,000 specimens, valued at $10,000. The total amount expended for this collection did not exceed $7,500. Apparatus and material used for college work has only a transient value, but the collection can never lose. With the increase of students and the care of material in hand, a larger appropriation is required.

ALFALFA LEAF SPOT DISEASE.—[*Pseudopeziza Medicaginis* (Lib. Sacc.]

BY ROBERT COMBS.

Synon: *Phacidium Medicaginis* Lib. (Plant. Ard. exs. 176).
Pseudopeziza Medicaginis Sacc. (Fungi Ard. No. 90).
Phyllachora Medicaginis Sacc. (Myc. Ven. pag. 145, tab. XVI, fig. 58-60).

Rehm gives it as *P. Trifolii* (Bernh.) Forma *Medicaginis* (Lib.)*

Lindau, (Engler & Prantl, Pflanzenfamilien, 130, Lieferung (1896) p. 215). after a short discussion of *P. Trifolii* (Bernh.) Fuck., says; "Eine als besondere Art unterschiedene Form kommt auf Medicagoarten vor."

This disease was first described by Libert in 1832. (Plant. Ard. exs. 176).

In 1840, Mazerius treats it more fully (Trans. Insular Soc. of Ag. Sci. and Arts p. 579), and again in 1843 (Crypt. Pl. France, Pt. XV).

In 1869 Fuckel mentions it as common throughout Germany. (Rheinischen Pilze, Wiesbaden, p. 263.) Frank briefly describes it in 1880 (Krankheiten der Pflanzen, Breslau (1889) II p. 548), and in 1896 (Pilzparasitaren Krankheiten der Pflanzen, p. 484), he treats it as a form of *P. Trifolii* (Bernh.) Fuck. Notwithstanding the treatments of Frank, Rehm, and Lindau to the contrary, I have taken the nomenclature of Saccardo (Sylloge Fungorum Vol. VIII (1889), p. 724), which seems to be more in accordance with the nature of the disease, as well as the laws of nomenclature. The disease in Iowa only occurs on the species of medicago (alfalfa etc.), and on clovers; the *complete* form of this *Pseudopeziza* is not common here. This fact, together with the morphological differences of the two diseases, seems sufficient to regard it as a distinct species.

The disease is most common on *Medicago sativa* L. (common alfalfa, or lucerne) but is reported as occurring on other species of *Medicago*, as *M. lupulina*, *M. minima*, *M. Willdenovii*, *M. corstenensis*, and rarely on *Trigonella*. I observed it this year (1897) on a plat of *M. media*. It has been recorded for Belgium, France, Germany, Italy, Spain, Siberia, countries of South America, and throughout the United States. In fact, it is found wherever alfalfa is grown.

In the United States, its first mention is probably when Sprague found it in New England and Pennsylvania in 1856 on *Medicago sativa* L., although it was not registered until 1875, by Berkley (Grevillia, Vol. IV, Sept., 1875, p. 6) and then under the old name of *Ascobolus Trifolii* Bernh., an old name for *Pseudopeziza Trifolii* (Bernh.) Fuck. It has no mention then until 1889, when Chester (Del. Agr. Exp. Sta. 2d Ann. Rept., pp. 94-95) records its presence in twenty experimental plats of alfalfa in different parts of Delaware, and in some cases came near destroying the crop. He treats the subject much more fully the following year (Del. Agr. Exp. Sta., 3rd Ann Rept., pp. 79-84). In this article a review of the whole subject is given, with cuts and descriptions of the external and microscopic characters. A few remarks as to treatment and the results of some experiments are also given. He sterilized the soil with heat and the seed with copper sulphate (10 per cent sol.), and found that the plants resulting from seed and soil thus treated became as badly diseased as those not treated. Since this time nothing has been done toward the further investigation of this most destructive of alfalfa diseases.

There is no doubt that this disease, which attacks the plant at any time after it has made a growth of four to six inches from the seed, is the principal cause of the non-success, or partial success, of this most excellent forage plant in this part of the country. When it attacks the plant early it prevents a good stand, and later it greatly retards the growth and vigor, because of the diseased condition of the leaves.

Professor Pammel, in 1891 (Fungus Diseases of Forage Plants of Iowa, p. 25) estimated the loss to the crop of alfalfa due to this disease at 50 per cent. These facts, together with the fact of its almost universal distribution wherever alfalfa is cultivated, seem to justify a further mycological and experimental study, and accordingly I have conducted some experiments, which, however, are but little more than preliminary.

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*Rabenhorst's Kryptogamen Flora, Vol. I, Abt. III, 37 Lief, p. 598.

Before discussing this and other experiments it will be necessary to give a description of the fungus which causes the disease.

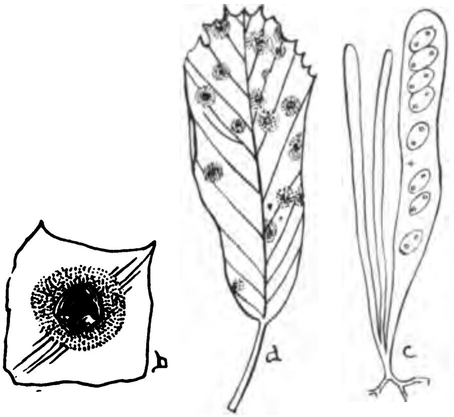

Fig. 1.

Fig. 1. *a*, Leaf enlarged, showing diseased spots; *b*, a spot enlarged, showing black apothecium in the center; *c*, paraphyses and an ascus containing ascospores. (Highly magnified.)

Small blackish brown specks appear usually upon the upper side of the leaves (Fig. 1*a*) which in a few days enlarge to about one-sixteenth of an inch in diameter, and extend through the leaf to the lower side, which becomes of a like color (perhaps a little lighter). The intervening leaf parenchyma also becomes brownish.

In the center of each well developed spot a small blackish pustule appears (Fig. 1*b*) upon the upper side and sometimes upon the lower side also. These pustules, called apothecia (sing. apothecium), soon rupture the epidermis or skin of the leaf, which rolls back or falls off, exposing an area which when viewed in cross-section and highly magnified, presents a cup-shaped mass of colorless, long club-shaped, sac-like bodies, standing upright (Fig 2). These bodies called asci (sing. ascus), each contain eight egg-shaped hyaline or colorless, one-celled bodies, called ascospores (Fig. 1*c* and Fig. 3), each of which has a nucleus and two oil globules.

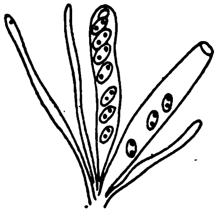

Fig. 3.

Fig. 3. Paraphyses and asci; one ascus showing the opening from which part of the spores have escaped.

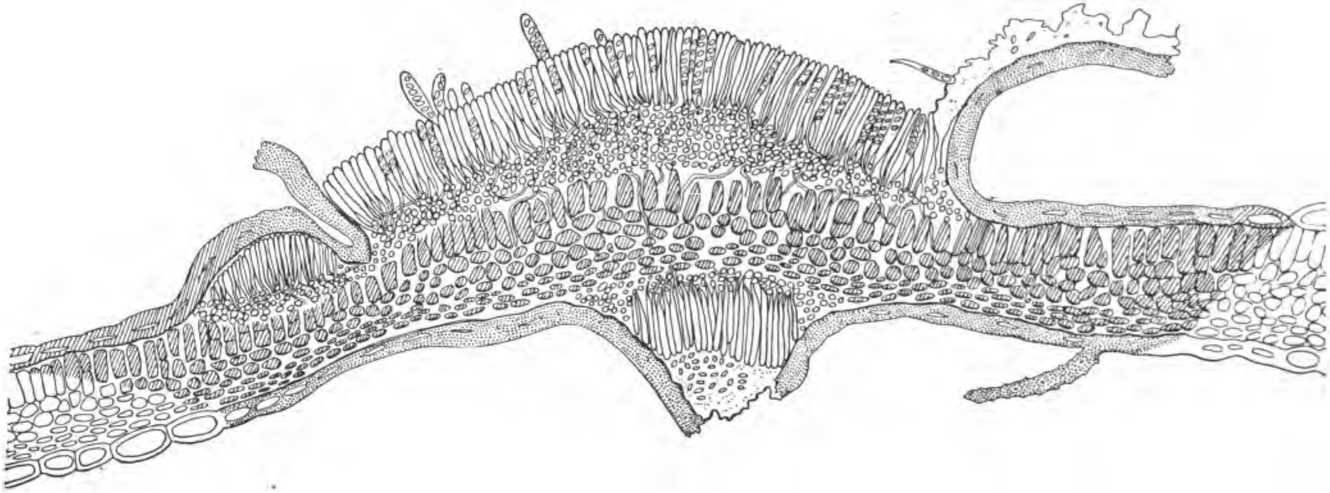

Fig. 2.

Fig. 2. Cross section of leaf through apothecium, showing reflexed epidermis and the protruding mass of intermingled paraphyses and asci containing ascospores (highly magnified).

They answer the same purpose as the seeds of higher plants. In culture solutions and rain water the ascospores germinate, producing a short tube or promycelium. The asci, along with certain thread-like sterile bodies called paraphyses, comprise the contents of the apothecia and arise from the vegetative thread-like mycelium of the fungus, which ramifies among the cells of the interior of the leaf (Fig. 4), obtaining nutrition from the cell contents mainly from the palisade parenchyma just beneath the upper epidermis or skin

When the fungus is ripe the ascospores make their way out of the ascus through an opening at the apex or outer end, are carried by the wind or other means to the same leaf or another leaf of the same or another plant, where, under the proper conditions of warmth and moisture, they germinate, producing a small tube which, although I have been unable to observe, most probably enters the leaf through the small openings called the breathing pores or stomata, upon the upper side, ramifies among the cells of the leaf, and after its vegetative period produces the fruiting pustules or apothecia above described.

This completes the life cycle as far as known. A pycnidial stage is often associated with the allies of this species, and in fact Tulasne (Sel. Fung. Carp., III, p. 141,) has called attention to the association with this species, of *Sporonema phacidioides* Desm., but this has not been generally accepted, as the relation seems not to have been clearly established.

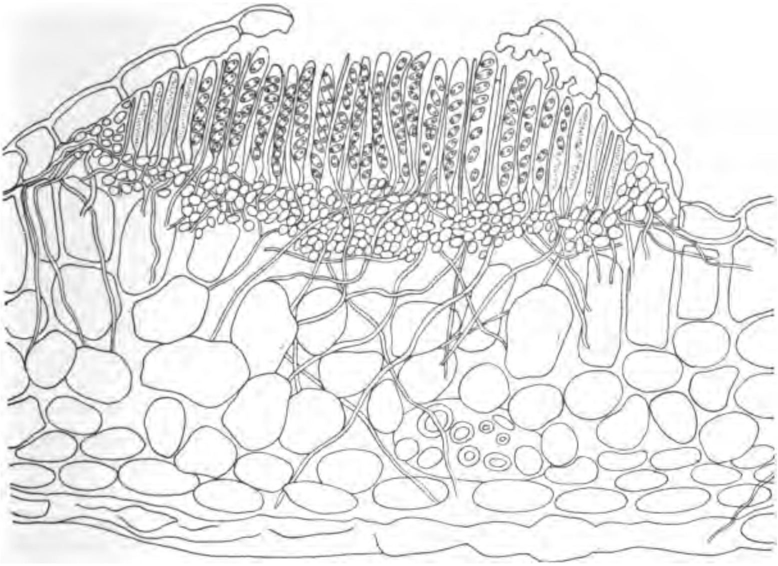

Fig. 4.

Fig. 4. Cross section of leaf through apothecium, showing the mycelium ramifying among the cells of the leaf. (Highly magnified)

Professor Chester's experiments pointed to atmospheric inoculation, *i. e.*, there was but little danger of infection from impure seed or infected soil. To prove this, however, I took growing plants in the field that were generally affected, cleaned away the debris and loose dirt, cut the plants off level with the ground, and then sunk bell jars into the ground around them, placing loose cotton stoppers into the top to facilitate communication with the outside air and still keep out all spores. When the plants came up again they were closely watched for about six weeks, but no signs of the disease appeared within the bell jars, while all the surrounding plants were seriously diseased. (Exp. No. 1.)

(Exp. No. 2.) August 1st, fresh untreated alfalfa seeds were planted in the greenhouse, some under three separate bell jars with loose cotton stoppers in the top, and some unprotected. Inoculations were made about August 20th, on the plants under jar No. 1 with spores germinating in water from hanging drop preparations, and on plants in No. 3 with dry, powdered, diseased leaves of alfalfa. August 30th a number of clearly defined spots had appeared in No. 3, but No. 1 remained clean, as did No. 2 (which had been left as a check) and the plants unprotected by bell jars.

(Exp. No. 3.) August 30th, a large lantern globe was carefully placed over some of the unprotected plants, and dry, powdered, diseased leaves were sprinkled over the confined plants and a sheet of cotton batting tied over the top. September 8th, clearly defined spots had appeared upon a great many leaves of the plants thus treated, while all of those not treated were perfectly healthy.

At different times between September 1st and 8th, microscopic examinations were made of the treated leaves, but no germinating ascospores could be found with their tubes entering the leaves as I had hoped, but as the disease appeared on the upper side, it is reasonable to suppose that the mycelium of germinating spores entered the leaf through the stomata on the upper surface where they had fallen.

(Exp. No. 4.) On September 6th one of the jars was taken from the perfectly healthy plants in the field (which had been used in Exp. No. 1) after having been there since July, and on September 30, numerous spots had appeared.

These experiments seems to clearly establish two facts,—1st, the plants become affected by the spores carried by the air; and 2d, the disease is strictly local, *i. e.* its mycelium does not affect the stem nor the root, but is confined to the limited brown spot on the leaf. This last is clearly verified by microscopic examination of cross sections of diseased leaves, for no abnormalities nor foreign structures can be detected in the leaf parenchyma outside of the brown area.

TREATMENT.

Since the disease readily survives the winter, and is carried by the wind as dust, it is advisable to burn the field in late fall or early spring. If there be not sufficient dry material on the field, straw or other combustible refuse of the farm may be spread over the field and burned.

The selection of seeds from unaffected plats, or the treatment of seeds of unknown purity with 10 per cent Cu So 4 before sowing, would be advisable. If seeds are drilled instead of sown, the danger from impure seed is much lessened, because of the fact that the spore must be in contact with the leaf to produce the disease, and when drilled they are buried beneath the soil.

In sown fields the spores would principally remain upon the surface of the soil and therefore be very liable to infect the leaves.

Frequent cutting in the crop is very effective in holding the disease in check.

SEED TESTING: ITS IMPORTANCE, HISTORY, AND SOME RESULTS, WITH A PARTIAL BIBLIOGRAPHY.

CARLETON R. BALL.

Importance.—The importance of seed-testing cannot be overestimated. Only in comparatively recent years have farmers and gardeners begun to appreciate the complex physiological and meteorological conditions which influence the production and germination of seed. In no line of agricultural industry has the farmer been more inclined to trust to chance, luck, good fortune, or some other patron saint of the art, than in the selection or purchase and planting of the seed from which he expected to raise a crop. It is true that the majority exercise considerable care in the selection of seed of the common cereal crops, but even here the pressure of false economy prompts some, when seeding their own fields, to use grain which is more or less damaged, and hence not readibly salable.

It was to educate the ignorant or negligent consumer, and to discover the dishonest or careless dealer, that so many experiment stations have undertaken the expensive and arduous labor of testing commercial seeds. It must not be thought that all seedsmen are guilty of mixing old seeds with their fresh stock, or of selling seeds which contain large amounts of weed seeds or other foreign material. On the contrary, we are sure that the great majority of them are honest and upright in their dealings. There are a few, however, as there are some in every line of commercial pursuit, who do not hesitate to employ fraudulent methods in the sale of seeds.

There is at present a certain demand for cheap seeds, and to this cause must be ascribed a part of the poorer seed found on the market. But the fact that the greater part of our commercial seeds are pure and vital does not make good the financial loss or heal the wounded feelings of the man who happens to purchase some of the lesser part which is neither pure nor vital. There is no doubt that all the honest seedsmen would welcome any system of seed control which would increase the demand for a better grade of seeds, and remove the injurious competition of the unscrupulous dealer. It is obvious that there are so many outside conditions of soil and weather which influence the resulting crop that the seedsman cannot and ought not to be held responsible for anything further than the quality of the seed he sells.

Some of the facts which a systematic and scientific testing of seeds by the experiment stations has shown, and will show with greater accuracy as this method obtains more extensively, are as follows:

(1) The reasonable standard of vitality or germinative energy which different seeds should possess, the actual vitality of the seeds tested, and the gradual decrease in vitality, and hence in real value, due to increasing age.

(2) The amount and nature of the impurities or adulterations, whether consisting of good but cheaper seed; of harmless but worthless material, as dirt, chaff, etc., or of seeds of noxious and troublesome weeds.

(3) The relative value of mature and immature seed; of large, heavy seed as compared with small, light seed, and similar physiological questions looking toward the improvement of plants.

(4) The action of different chemical substances used for treating seeds against insect and fungus enemies.

If the farmer or gardener buys seed which by reason of age or improper handling has lost its vitality, he suffers direct loss. This loss is not only the original cost of the seed but what is of greater consequence, the immediate use of his land and the labor, fertilizer, etc., required in preparing and planting it.

Again, he may buy seeds which contain a considerable amount of impurities. These are either dirt, sticks, chaff, broken seeds, and weed seeds, resulting from careless growing and ineffective cleaning, or else they consist of similar but much cheaper seeds or, in some cases, of skillfully polished and colored grains of quartz sand, purposely mixed with a varying quantity of the true seed which is offered for sale. The purchaser of such seed also suffers a money loss in proportion to the amount of the adulteration. He also runs a great risk of introducing into his fields many noxious weeds which cost him much time and labor to eradicate and which sometimes spread so rapidly as to seriously threaten the agricultural interests of large areas.

A more accurate and widely diffused knowledge of the principles of seed selection would save many farmers from planting seed grain which was either immature or had been so injured by climatic conditions as to be incapable of germinating and producing healthy, vigorous plants. It would also aid the gardener in selecting his seed in order to obtain an earlier maturing fruit and so secure better markets and avoid the danger of early autumn frosts. So, too, he might, without any additional cost, select seed that by its greater supply of food for the young plant, would give him more vigorous growth and more abundant production, thus increasing his profit.

There are many chemical substances which may be effectually used to destroy weevils and other insects which injure seeds. Some compounds are used to destroy the spores of smuts and other fungus diseases which gain an entrance to the plant through the germinating seed. Some of these substances materially hasten the germination of seeds treated with them. Some are beneficial when used in solutions of moderate strength and for short periods of time but are very injurious to the delicate germ in the seed when the solution becomes stronger or the treatment is prolonged.

SEED CONTROL IN EUROPE.

Organized seed control was first heard of in Germany. A station for testing commercial seeds was organized in 1869, in connection with the forestry academy already located at Tharandt. Its inception was due to the investigations of Dr. Nobbe, who became its director.

The disclosures made by him in regard to the poor quality and serious adulteration of commercial seeds, especially the grasses and clovers, awakened a general popular interest in the subject. The seedsmen and farmers recognized at once the mutual benefits to be derived from the scientific and impartial seed control. The former were better enabled to satisfy their customers by guaranteeing the quality of their wares, and were themselves protected from the injurious competition of unscrupulous and dishonest dealers. The latter were enabled to purchase reliable seeds at no additional cost. These methods grew in favor very rapidly and several stations were soon organized in different parts of Germany. Other countries soon followed her example. In 1895 there were about one hundred and twenty of these stations in Europe and similar organizations in Brazil, Japan and Java. The progress of this work in America is treated of in another part of this paper.

These numerous stations, although varying somewhat in accordance with the peculiar needs of their patrons in the different countries, are pursuing essentially the same general method in their work. Nearly all have been established by the governments and are supported partly by appropriations and partly by the fees received for their services.

Seeds are tested for purity and vitality. For the smaller and lighter seeds a sample of 100 grams weight (about 3½ oz. avoir.) is required, but for the larger, heavier seed it must be 250 grams. The fees vary according to the completeness of the test. For testing vitality the fees vary from 75 cents to $2.50 according to the size and character of the seed. For specifying the impurities the fees run from $1.25 to $6.25, with additional charges for determining dodder in clover seed. When the test is completed a report is sent to the customer stating the percentages and nature of the impurities and the percentage of vital seed.

The seed control station at Zurich, Switzerland, may be taken as a type of the higher grade of efficiency reached by these stations. It has an international reputation and is largely patronized by seedsmen in the other countries of Europe, as they prefer it to those of their own countries. All persons offering seeds for sale in Switzerland are required by the federal law to have them tested at the Zurich station, and to place upon each package the percentage of purity and vitality as determined by the station test.

For their foreign patrons, they have two different kinds of contract. Under the first, which is known as the "private contract," the dealer, by the payment of a certain annual sum, is privileged to send a specified number of samples to the Zurich station each year for complete analysis. He has these tests made largely for his own satisfaction as to the quality of the seed he sells, and they do not give his customer any guarantee from the Zurich station.

The second is what is called the "control contract" system. The seed merchant under this system is permitted to have a specified number of seed samples tested during the year in return for the payment of an annual fee. He s also allowed to announce himself to his customers as "under control of the Swiss Seed Control Station." Each of his customers receives with his seeds a duplicate report of the test made at the Swiss station. If the purchaser suspects that the seed is inferior to the guaranteed quality, he may send it to the control station for analysis free of charge. The sample so sent must be taken in the presence of two reputable witnesses from an unopened package of seed received from the dealer. This sample is then placed in a sack, sealed, and mailed to the Zurich station in the presence of these witnesses, who must then certify to the fact.

This thoroughly organized public control of commercial seeds has been very favorably received by all concerned. Seedsmen in general were only too glad to respond to the demand for pure, viable seeds. They were now enabled to do this with confidence in the good quality of their seeds and free from the corrupt competition of dishonest dealers, who were forced either to quit the business or better the quality of their goods. The control system in Europe has thus resulted in a very marked improvement in the quality of the seed offered for sale. This has been accomplished not only without additional expense to the consumer, but on the contrary, oftentimes an actual saving to him because a smaller quantity of the good seed was required than of the poorer seed formerly sold.

SEED TESTING IN AMERICA.

The necessity for improvement in the quality of commercial seed was not felt in America until a later period than in Europe. This does not necessarily indicate that the American agriculturist is less progressive than his European brother, but is rather to be attributed to the different conditions which prevailed here in this country. In the first place, it is doubtful whether there was as much fraud and adulteration of seed practiced in America as there was at that time in Europe, where Nobbe found firms whose sole business was the manufacture of imitation clover seed from polished and colored grains of quartz sand. We must admit, however, that some of the bogus clover seed found its way across the ocean.

Again, in this country, during the first years succeeding the settlement of the great agricultural areas of the west, extensive farming was the rule. With soil of seemingly inexhaustible fertility, prevailing high prices for produce and comparatively little competition, the most indifferent methods of farming gave immediate and profitable returns. Gradually, however, these conditions became reversed. The soil became depleted of the chemical elements necessary for plant nourishment. Competition at home and abroad became stronger, and for several reasons the price of farm products fell. The civil war and the financial panic of twenty-five years ago added to the increasing burden of the farmer, and he felt the need of improved and economic methods.

To discover and promote these methods was one of the functions for which the agricultural experiment stations were called into existence. It was necessary to return to the soil those elements of which it had been robbed through ignorance of the laws of plant growth. The manufacture and use of commercial fertilizers increased rapidly, but their complex composition made frauds comparatively easy, and this soon caused a universal demand for a reliable public control of these substances. This work of analyzing and reporting was delegated to the various experiment stations, and has since been carried on with great benefit and satisfaction to all parties. Having thus provided the growing plants with the elements necessary for their nourishment, attention was called more plainly to the quality of the seed from which the crop was to be raised.

The pioneers of America in this line of investigation were Prof. E. H. Jenkins of the Connecticut Experiment station, in 1877; Prof. W. J. Beal of the Michigan Experiment station, in 1877; and Dr. Albert R. Ledoux. of the North Carolina Experiment station, in 1879. The work of the latter station has been continued without interruption up to the present time, having been under the able management of Prof. Gerald McCarthy since 1888. For complete equipment and long continued careful investigation it probably stands at the head of this work in America to-day.

Valuable experiments have also been carried on at the experiment stations in Arkansas, Delaware, Illinois, Indiana, Iowa, Maine, Massachusetts, Minnesota, North Dakota, New Mexico, New York (State), New York (Cornell), Pennsylvania, Rhode Island, South Carolina, South Dakota, Vermont, Wisconsin, the Dominion station at Ottawa, and the Ontario station at Guelph, Ontario, Canada. The United States department of agriculture has encouraged the work in many ways and has published several papers on the subject in recent years. Mr. Gilbert H. Hicks, in charge of the seed investigations of the division of botany, has made tests of all seeds distributed annually by the government under act of congress, and has established a tentative standard of purity and vitality for different seeds.

Only two states, so far as known, have laws on the subject of commercial seeds. North Carolina, in 1891, enacted that all vegetable or garden seeds offered for sale in that state should bear the date when the seed was grown, plainly marked on the package containing the seed. Maine, during the present year, passed a law requiring that all agricultural seeds, in bulk or package of one pound weight or more, shall be accompanied by a guarantee of their percentage of purity and freedom from foreign matter. This action was probably due to the agitation of the noxious weed question in Maine and is certainly a step in the right direction. Professor Harvey of the Maine station believes that the agricultural seeds and the feeding stuffs shipped into the state from surrounding states are the sources of the seeds of the weeds against which they are compelled to wage war.

SOME RESULTS OF SEED TESTS, 1897.

The following tables show the results of some tests made during the current year. The seeds were bought in February, 1897, direct from the different seedsmen, by outside agents of the station, and hence the dealers were not aware that the seeds were to be used for testing. The seeds were supposedly of the crop of 1896. The spring test referred to in the tables was made in May and the fall test in August, from seed from the same packages. The tests were all made in sand mixed with a little black loam, on benches in the greenhouse, and all were subjected to the same conditions of soil, temperature and moisture.

The tables show the number of seeds of each kind planted; the dormant period, or the time in days from date of planting until the first sprout appeared; the total number of plants that appeared at the end of the first, second, third, fourth, tenth and fourteenth days respectively, after germinating plants appeared; the percentage of germinating seed in each test; the average of the two tests; and lastly, the general average of vitality of all the seeds from each separate seedsman. The seeds were not tested for purity nor for the reliability of the varietal name.

The vitality tests show that for the most part they were fairly good seed, but still considerably below the standard established by European and American tests. It will be noticed, too, that some seedsmen ranked considerably above others in the general average vitality of their seeds in both tests. There was in the case of some seeds an increased vitality at the second test, while in many others the percentage of germinable seeds had decreased materially. In most seeds the decrease would naturally be looked for if any change was to be expected, In the seeds of cucurbits (pumpkin, squash, melon, cucumber, etc.), however, the almost uniform increase in vitality at the later test is in accordance with both popular belief and the results of many experiments made by different investigators. It is believed that most melon seeds germinate best when two or three years old.

It is intended to lay in such a supply of material as will enable these tests to be continued for several successive years. It will thus be possible to determine the gradual decrease in vitality of seeds, due to increasing age. It is certain that individual tests are of little value, but that by the careful comparison of many results, with due regard to all external conditions, important facts and principles may be established in relation to seeds.

SEEDSMAN "A."

KIND OF SEED.	SPRING TEST—NO. GERMINATED.										FALL TEST—NO. GERMINATED.										Av. per cent of two tests.
	No. planted.	Dormant period.	First day.	Second day.	Third day.	Fourth day.	Tenth day.	Fourteenth day.	Total No. germinated.	Per cent germinated.	No. planted.	Dormant period.	First day.	Second day.	Third day.	Fourth day.	Tenth day.	Fourteenth day.	Total No. germinated.	Per cent germinated.	
Cabbage, Early Jersey Wakefield....	50	10	5	13	19	24	29	29	29	58	25	5	15	15	15	15	15	15	15	60	59
Cauliflower, Early Paris.............	50	9	15	26	35	38	42	42	42	84	25	5	5	8	8	8	9	9	9	36	60
Cress, Curled....	50	6	5	21	28	35	41	42	42	84	25	5	2	7	7	7	9	9	9	36	60
Lettuce, Market Gard'n, Private Stk.	50	7	2	33	48	48	49	49	49	98	25	6	1	2	2	3	8	11	12	48	73
Onion, Large Red Wethersfield.... ..	50	11	9	30	35	35	38	38	38	76	25	11	2	4	5	6	10	10	10	40	58
Sage.....................................	50	11	22	27	30	33	43	45	45	90	25	9	2	2	2	5	17	17	17	68	79
Alfalfa	50	5	13	36	40	40	42	42	42	84	25	9	3	7	10	11	12	12	12	48	66
White clover	50	6	24	39	42	44	47	48	48	96	25	12	2	3	4	5	10	10	10	40	68
Red clover............................	50	6	26	37	38	40	42	42	42	84	25	7	1	1	2	2	7	7	7	28	56
Peas, Alaska......	25	6	7	12	15	18	18	18	18	72	25	7	7	10	13	13	13	13	13	52	62
Beet, Early Colorado Turnip.	25	7	13	15	18	21	21	21	21	84	25	7	6	9	11	14	17	17	17	68	76
Spinach, Long Standard..............	50	6	6	12	17	21	33	38	40	80	25	10	4	5	6	7	17	17	17	68	74
Parsnip, Abbott Improved....... ...	50	13	13	19	27	30	33	33	33	66	25	12	7	9	9	12	18	18	17	72	69
Carrot, Half Long Danvers.	50	10	32	38	43	43	44	44	44	88	25	11	3	3	4	7	14	14	14	56	72
Tomato, Ignatum......	50	10	18	24	26	27	31	34	34	68	25	8	4	7	8	9	13	13	13	52	60
Cucumber, Imp. White Spine.........	25	6	2	12	18	18	18	18	18	72	25	4	9	12	15	15	17	17	17	68	70
Squash, White Scallop Bush	25	9	8	13	19	20	21	21	21	84	20	8	9	11	15	15	17	17	17	85	84.5
Pumpkin, Large Cheese..............	25	10	1	7	12	12	12	12	12	48	0	6	1	3	5	5	8	10	11	55	51.5
Watermelon, Kolb Gem...............	25	11	3	3	4	4	4	4	4	46	20	8	4	7	11	14	17	17	17	85	50.5
Muskmelon, L. I. Beauty............	25	10	2	7	9	11	15	15	15	60	25	5	3	4	5	8	13	16	16	64	62

SEEDSMAN "B."

KIND OF SEED.	SPRING TEST—NO. GERMINATED.										FALL TEST—NO. GERMINATED										Av. per cent of two tests.
	No. planted.	Dormant period	First day.	Second day.	Third day.	Fourth day.	Tenth day.	Fourteenth day.	Total No germinated.	Per cent germinated.	No. planted.	Dormant period	First day.	Second day.	Third day.	Fourth day.	Tenth day.	Fourteenth day.	Total No. germinated.	Per cent germinated.	
Cabbage, Large Late Flat Dutch....	50	10	10	14	16	16	20	20	20	40	25	5	7	8	9	11	13	14	14	56	48
Cauliflower, Extra Early Paris.... ..	50	7	1	1	5	20	35	35	35	70	25	5	3	7	7	7	9	9	10	40	55
Cress, Curled.......	50	6	8	36	39	41	46	48	48	96	25	6	3	4	4	4	4	4	4	6	56
Lettuce, Early Curl Silesian..........	50	7	7	32	8	4	49	49	49	98	25	11	2	3	4	5	16	16	16	64	81
Onion, Extra Early Gold Seal.......	50	14	1	5	7	8	8	8	8	16	25	..	..	..		..	..	..	..	..	8
Sage...................................	50	1	1	1	1	1	9	13	14	28	25	9	6	6	7	9	12	12	12	48	38
Alfalfa	50	5	13	34	36	36	40	40	40	80	25	6	8	8	8	10	13	14	15	60	70
White clover, Dutch............... ..	50	5	3	29	36	36	39	39	39	78	25	7	1	1	2	4	14	17	17	68	73
Red clover..........................	50	6	26	37	38	40	42	42	42	84	25	7	2	2	3	3	6	7	7	28	56
Peas	25	6	7	15	18	21	21	22	22	88	25	9	4	7	9	10	13	13	13	52	70
Beet, Early Blood Red Turnip.......	25	7	17	18	19	19	19	19	19	78	25	6	2	6	10	14	16	16	16	64	71
Spinach, Bloomsdale	50	7	1	3	5	5	7	7	7	14	25	1	1	1	2	22	5	5	5	20	17
Parsnip, Bloomsdale......	50	13	3	7	7	10	14	14	14	56	25	12	3	6	7	10	14	14	14	56	56
Carrot, Oxheart.....	50	10	29	32	35	35	39	39	39	78	25	10	1	1	1	1	12	12	12	48	63
Tomato, Early Richmond	50	10	13	17	20	21	27	27	27	54	25	10	5	6	7	10	14	15	15	60	57
Cucumber, Early Imp. White Spine.	25	6	11	17	20	20	20	20	20	80	25	5	2	2	4	7	14	14	14	56	68
Squash, Early White Bush.	25	9	2	5	8	16	16	16	16	64	20	8	2	5	7	11	17	17	17	85	74.5
Pumpkin, Cashaw..................	25	10	11	12	12	14	15	15	15	60	20	5	2	5	7	9	13	14	14	70	65
Watermelon, Arkansas Traveler....	25	11	3	3	3	3	5	6	6	24	20	10	7	8	8	9	11	11	11	55	38.5
Muskmelon, Extra Early............	25	10	1	19	19	19	20	20	20	80	25	8	4	5	8	8	15	17	17	68	74

SEEDSMAN "C."

KIND OF SEED	SPRING TEST—NO. GERMINATED.										FALL TEST—NO. GERMINATED.										
	No. planted.	Dormant period.	First day.	Second day.	Third day.	Fourth day.	Tenth day.	Fourteenth day.	Total No. germinated.	Per cent germinated.	No. planted.	Dormant period.	First day.	Second day.	Third day.	Fourth day.	Tenth day.	Fourteenth day.	Total No. germinated.	Per cent germinated.	Av. per cent of two tests.
Cabbage, Early Jersey Wakefield	50	9	33	34	37	38	41	41	41	82	25	5	9	12	13	14	16	16	16	64	73
Cauliflower, Henderson's E Snowball	50	7	7	24	31	32	40	40	40	80	25	5	6	9	9	9	10	10	0	40	60
Cress, Extra Curled	50	6	23	29	34	38	42	42	42	84	25	9	1	1	1	1	1	1	1	4	44
Lettuce, Imp. Hanson	50	7	38	42	47	47	50	50	50	100	25	6	6	7	7	7	12	14	14	56	78
Onion, Large White Globe	50	12	5	15	23	30	36	36	36	72	25	9	4	6	7	11	11	11	12	48	60
Sage	50	11	2	6	6	88	14	17	17	34	25	11	2	5	7	9	9	9	9	36	35
Alfalfa	50	5	14	30	30	30	32	33	33	66	25	6	8	11	11	11	11	11	11	44	55
White clover	50	5	2	14	32	38	43	43	43	86	25	7	14	15	16	16	18	19	19	76	81
Red clover	50	5	1	20	31	32	35	36	36	72	25	7	9	10	13	14	17	17	17	68	70
Peas	25	6	4	5	5	5	5	6	8	32	25	6	3	6	9	11	13	13	13	52	42
Beet, Dewing's Imp. Blood	25	7	8	8	9	9	10	11	11	44	25	7	1	5	8	10	15	15	15	60	52
Spinach, New Zealand	25	13	4	4	5	6	16	16	16	64	25	5	2	4	7	8	13	15	15	60	62
Parsnip, Imp. Guernsey	50	13	1	7	13	16	24	24	24	48	25	10	3	3	3	3	13	13	13	52	50
Carrot, Oxheart	50	10	17	20	25	25	29	29	29	58	25	8	3	5	7	9	13	13	13	52	55
Tomato, Dwarf Champion	50	10	16	29	43	44	46	47	47	94	25	10	14	16	17	18	18	18	18	72	83
Cucumber, Per. White Spine	25	6	13	14	17	17	17	17	17	68	25	4	5	12	14	16	20	20	20	80	74
Squash, Hubbard	25	11	8	8	8	8	8	8	8	32	...	...	...	...	...	...	...	...	...	...	...
Pumpkin, Large Cheese	25	10	1	2	2	2	2	2	2	8	20	6	2	5	7	9	12	12	12	60	34
Watermelon, Sweetheart	25	11	6	8	9	9	10	10	10	40	20	5	1	1	3	3	10	12	12	60	50
Musk melon, Imp. Gr. Nutmeg	25	10	3	13	14	16	17	18	19	76	25	5	6	6	7	7	17	19	20	80	78

SEEDSMAN "D."

KIND OF SEED.	SPRING TEST—NO. GERMINATED.										FALL TEST—NO. GERMINATED.										
	No. planted.	Dormant period.	First day.	Second day.	Third day.	Fourth day.	Tenth day.	Fourteenth day.	Total No germinated.	Per cent germinated.	No. planted.	Dormant period.	First day.	Second day.	Third day.	Fourth day.	Tenth day.	Fourteenth day.	Total No germinated.	Per cent germinated.	Av. per cent of two tests.
Cabbage, Ex. Ea. Jersey Wakefield	50	9	21	25	27	29	41	41	41	82	25	5	9	11	12	11	14	14	14	56	69
Cauliflower, Early Paris	50	7	3	14	26	30	36	36	36	72	25	5	5	9	10	10	10	10	10	40	56
Cress, Extra Curled	50	6	19	23	23	23	27	27	27	54	25	5	6	6	6	6	6	6	7	28	41
Lettuce, Boston Market	50	7	43	43	45	45	46	46	46	92	25	6	2	5	7	8	15	17	17	68	80
Onion, Danvers Flat Yellow	50	16	8	8	8	9	9	9	9	18	25	18	1	1	1	1	1	1	1	4	11
Sage	50	11	2	3	3	3	4	5	5	10	25	9	1	1	1	2	4	4	4	16	13
Alfalfa	50	5	26	33	34	36	36	36	36	72	25	6	12	12	12	12	12	13	13	52	62
White clover	50	5	3	37	37	37	42	42	42	84	25	7	8	8	8	10	14	16	16	64	74
Red clover	50	5	4	27	40	40	40	40	40	80	25	7	6	6	6	7	9	16	16	64	72
Peas, Telephone	25	6	1	2	2	3	3	3	3	12	25	7	1	1	4	4	4	4	4	16	14
Beet, Early Bassano	25	7	13	13	14	15	17	17	17	68	25	6	1	5	7	10	17	17	17	68	68
Spinach, Round Summer	50	6	4	12	12	14	15	16	16	32	25	5	1	3	3	4	8	8	8	32	32
Parsnip, Salzer's Crown	50	15	7	19	27	29	37	37	37	74	25	11	1	3	4	9	19	21	21	84	79
Carrot, Scarlet Nantes	50	10	39	39	43	43	44	44	44	88	25	8	1	1	3	6	9	9	9	36	62
Tomato, Early Acme	50	10	43	43	45	45	45	45	45	90	25	6	3	9	14	14	19	19	19	76	83
Cucumber, Early Market	25	6	12	14	18	18	19	19	19	76	25	4	7	12	14	14	14	15	15	60	68
Squash, Perfect Gem	25	9	6	8	9	9	11	11	11	44	20	6	2	2	4	4	5	6	6	30	37
Pumpkin, Corn Field	25	10	8	9	9	9	9	9	9	36	20	5	2	7	7	8	8	10	10	50	43
Watermelon, Hungarian Honey	25	10	4	10	10	10	11	11	11	44	20	5	5	15	15	16	17	18	18	90	67
Muskmelon, Green Nutmeg	25	10	19	20	20	20	20	20	20	80	25	5	11	21	21	22	22	22	22	88	84

SEEDSMAN "E."

KIND OF SEED.	SPRING TEST—NO. GERMINATED.										FALL TEST—NO. GERMINATED.										
	No. planted.	Dormant period.	First day	Second day.	Third day.	Fourth day.	Tenth day.	Fourteenth day.	Total No. germinated.	Per cent germinated.	No. planted.	Dormant period.	First day.	Second day.	Third day.	Fourth day.	Tenth day.	Fourteenth day.	Total No. germinated.	Per cent germinated.	Av. per cent of two tests.
Cabbage, Holland	50	9	34	36	40	41	42	44	44	88	25	5	2	5	11	14	16	16	16	64	76
Cauliflower, Early Snowball	50	9	12	15	15	17	23	23	23	46	25	5	5	5	6	6	8	8	9	36	41
Cress, Water	50	..	..	..	..	..		..		..	25	..	..	..	..	..	..	..	..	..	....
Lettuce, Golden Ball	50	7	30	36	48	48	49	50	50	100	25	6	3	5	5	5	5	5	5	20	60
Onion, Large Red Wethersfield	50	11	9	21	28	28	34	34	34	68	25	9	1	2	4	5	8	8	8	32	50
Sage	50	11	6	6	10	14	18	19	21	42	25	12	2	3	3	3	3	3	3	12	27
Alfalfa	50	5	23	33	34	34	37	38	38	76	25	6	5	5	5	5	9	12	12	48	62
White clover	50	6	26	26	26	30	33	33	33	66	25	7	1	1	1	1	5	6	6	24	45
Red clover	50	6	2	37	44	44	46	46	46	92	25	7	1	1	1	1	3	7	7	28	60
Peas	25	6	1	7	9	14	14	15	15	60	25	9	2	2	3	4	4	4	6	24	42
Beet, Edmunds Early Blood	25	7	4	9	15	18	18	18	20	80	25	6	5	7	7	11	11	11	11	44	62
Spinach, Long Standing	50	5	8	8	15	15	21	21	21	42	25	9	3	3	5	6	7	7	7	28	35
Parsnip, Hollow Crown	50	13	3	7	10	14	29	29	29	58	25	13	1	1	1	1	1	12	2	8	33
Carrot, Danvers Half Long	50	10	18	21	25	26	30	31	31	62	25	10	1	3	4	5	12	12	12	48	55
Tomato, Acme	50	9	30	32	35	35	40	40	40	80	25	6	1	7	15	17	21	23	23	92	86
Cucumber, Imp. Long Green	25	6	12	14	17	17	18	18	18	72	25	4	15	22	22	22	23	23	23	92	82
Squash, Improved Hubbard	25	9	8	9	10	10	11	11	11	44	12	5	2	3	5	6	9	9	9	75	59.5
Pumpkin, Sweet or Sugar	25	6	5	6	9	13	16	17	17	68	20	4	1	8	11	12	16	17	17	85	76.5
Watermelon, Early Phinney	25	10	3	10	12	12	14	14	15	60	20	5	4	12	12	13	14	14	14	70	65
Muskmelon, Nutmeg	25	10	15	17	17	17	17	17	17	68	5	4	1	17	19	19	21	22	22	88	78

A PARTIAL BIBLIOGRAPHY OF AMERICAN SEED TESTING AND SELECTION.

It is the intention of the author to complete this bibliography as fast as time and facilities will permit. The hope that it may be of some use to those interested in seed testing is his warrant for publishing it before completion.

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DEPARTMENT OF ZOOLOGY, ENTOMOLOGY AND GEOLOGY.

HERBERT OSBORN, PROFESSOR.

With the exception of the addition of a course in embryology in the first term of the senior year, the course of study in this department remains essentially the same as heretofore, and is fully outlined in the college catalogue.

The equipment in way of apparatus and collections has materially increased during the biennial period and the opportunities for thorough work in the lines covered in the department thereby enhanced.

In the laboratory the addition of new microscopes and a rocking microtome, with a number of minor pieces of apparatus, and for the classroom a projection lantern outfit with a large number of lantern slides in zoology and geology, are the most important.

The additions to the collections have been numerous, and, while but few single additions of special importance have been made, the aggregate has given us a very decided gain. A fine bactrian camel was secured through the efforts of one of our graduates, Dr. E. K. Paine, at a cost so slight as to make it practically a donation. We have also secured a fine specimen of a bull fur seal and a young of the same species from President Jordan of the Leland Stanford Jr. University, at a cost representing simply the expense of preparation and so small as to be really a gift. Specimens of kangaroo, Rocky Mountain goat, elk and smaller mammals, and a number of birds have been added, among the latter a golden eagle from Mr. Mann, of Algona. Some birds of paradise, toucans and parrots secured by purchase may also be mentioned.

A large number of insects have been secured by our own collecting in the vicinity of the college and at other points in the state, especially Sioux City, Little Rock, Cherokee and Burlington; a fine series of *Hemiptera* from Mexico from Professor Townsend, and other collections of insects from Montana, Cuba, and Kentucky obtained by purchase or exchange.

The collections in geology and mineralogy have been enriched by additions of a series of educational specimens donated by the United States Geological Survey; a series of Lake Superior rocks, especially valuable as representing the typical formations studied in that region; a collection of rocks made by Dr. Beyer in his recent Russian trip, including especially, series from the Ural Mountains; many photographs; and a series of thin sections of typical rocks prepared in Germany. Dr. H. F. Bain, of the State Geological Survey, has deposited a valuable series of rocks and minerals, which, while subject to withdrawal, will be of great service in the department. We have also had the gift of a number of fine samples of the "Iowa marble" from the Le Grand quarries. If we add to these the numerous specimens collected by the department in the ordinary course of work, and sundry donations from students, it will be seen that there has been a very substantial growth in this line.

As usual, we have had frequent calls for information and the determination of specimens in all these lines, and it is evident that our collections are in this way useful to a large number of people outside the number of students who have daily access to them.

DEPARTMENT OF GENERAL AND APPLIED CHEMISTRY.

A. A. BENNETT, PROFESSOR.

The course of instruction in this department occupies two and one-half years, which may be supplemented by two years of graduate study. It is the aim to improve the means and methods of instruction from year to year. During the biennial period just past there has been added facilities for the study and practice of assaying and metallurgy and blowpipe analysis. These branches of applied chemistry occupy a large room in the basement, and is fitted with tables, furnaces, balances and other necessary apparatus for carrying on the processes of assaying and blowpipe analysis. The room and fittings accommodate sixteen students working at one time. Each table is supplied with gas and an air blast, the latter being especially useful to the blowpipe analyst.

The course of chemical instruction in the course in mining engineering begins in the middle of the sophomore year and extends throughout the remainder of the course. The work forms a good foundation for the application of chemical principles to mining problems. This work in applied chemistry is open to students in other courses under the proper conditions.

The other courses of study embrace general chemistry, qualitative and quantitative analysis, elementary organic chemistry, preparation of organic compounds, organic analysis, ultimate organic analysis, and physiological chemistry. Students who carry the study of chemistry through the undergraduate course may pursue the study two years longer as graduate students

The student electing chemistry in his junior and senior years completes his work by a thesis on some subject connected with the special work he has pursued.

Teachers of chemistry in the public schools of the state will find here good advantages for the laboratory study of chemistry, the only really profitable method of study. A year's study will give a good foundation in general chemistry and qualitative analysis.

The laboratory is very well equipped with apparatus and chemicals for the work open to students. It has accommodations for over 200 students.

The cost to the students is small when compared with the usual charges No fees or tuition are charged, but merely the cost of the apparatus and chemicals actually used.

The method of instruction is a combination of recitation and laboratory study. The work done in the laboratory is the basis of the recitation and always precedes it. The time of the head of the department and two instructors is continuously employed in giving instruction in the class-room and in the laboratory.

DEPARTMENT OF AGRICULTURAL CHEMISTRY

J. B. WEEMS, PROFESSOR.

I have the honor of presenting the following report for the department of agricultural chemistry for the years 1895–1896 and 1896–1897:

The past two years has been a period during which there has been a great many improvements made in the equipment of the department. The beginning of this period found the department with little or nothing with which to meet the demands made upon it for instruction in agricultural chemistry, and the present time finds the department equipped to such an extent that it can meet most of the demands made by the students in agricultural chemistry.

The general analytical work of the department has been largely work for the state geological survey and the state dairy commissioner. The value of the apparatus, chemicals, etc., belonging to the department is given below, and for comparison the inventory of November 1, 1895, is presented:

	Nov. 1, 1897.	Nov. 1, 1895.
Apparatus	$ 711.81	$ 36.02
Chemicals	83.69	2.95
Office furniture, etc	90.08	38 00
Total	$ 855 58	$ 76 97

DEPARTMENT OF MATHEMATICS AND POLITICAL ECONOMY

E. W. STANTON, PROFESSOR.

The following schedule shows the classes taught in this department during the biennial period:

TAUGHT BY THE HEAD OF THE DEPARTMENT.

CLASSES.	RECITATIONS PER WEEK.	NO. OF STUDENTS. 1896.	1897.
First term—			
Calculus, first division	5	21	25
Calculus, second division	5	14	13
Plane trigonometry (ten weeks)	5	39	32
Algebra, first division	5	48	40
Political economy, senior	5	17	18
Second term—			
Analytics, first division	5	22	25
Analytics, second division	5	31	24
Geometry	5	32	41
Political economy, junior	5	82	89
Political economy, senior	3	..	8
Theses	--	10	7

TAUGHT BY MISS ROBERTS.

CLASSES.	RECITATIONS PER WEEK.	NO. OF STUDENTS. 1896.	1897.
First term—			
Trigonometry, second division (nine weeks)	5	36	33
Trigonometry, third division (nine weeks)	5	43	37
Algebra, second division	5	43	45
Algebra, third division	5	37	24
Spherical trigonometry (seven weeks)	5	25	15
Spherical trigonometry, second div. (seven weeks)	5	24	19
Second term—			
Geometry, second division	5	23	11
Geometry, third division	5	24	15
Geometry, fourth division	5	33	27
Advanced algebra, first division	3	24	23
Advanced algebra, second division	3	26	22

TAUGHT BY SECOND ASSISTANT.

CLASSES.	RECITATIONS PER WEEK.	NO. OF STUDENTS. 1896.	1897.
First term—			
Algebra, agricultural division	5	21	27
Second term—			
Algebra, agricultural division	3	30	38
Algebra, preparatory course	5	25	35

In addition to the classes taught by the second assistant she had charge of the accounts in the secretary's office.

The work of the department during the last two years has had in it much of encouragement. In the mathematical classes the requirement that the student must have a satisfactory record in the lower study before advancing to the higher has been rigidly enforced. Special pains has been taken to give to all the opportunity of gaining a thorough mastery of the principles involved in the elementary study, and of acquiring expertness and accuracy in their application. The student has then been held to the strictest accountability as to results, and admitted to the higher work only upon satisfactory proof that he could carry it forward successfully. The effect upon the department has been in every way satisfactory. Experience has shown fully that as many enter the advanced classes under these strict requirements as under lax regulations; while the work accomplished is of a higher order.

The advance in the requirements for admission and the consequent changes in the courses of study decided upon at the last annual meeting of the board of trustees, will necessitate a reorganization of the mathematical work. The greater portion of the algebra which has hitherto been taught in the first term of the freshman year together with plane geometry, until now included in the course of the second term, will be transferred to the academic year. The first half of the freshman year will hereafter be devoted to advanced algebra, to which class no one can secure admission except upon the basis of a satisfactory record in the algebra of the academic course, or upon examination held under he direction of the mathematical department. Solid geometry and plane trigonometry will be completed in the second term of the freshman year. Analytical geometry and calculus can be taken in the first and second terms of the sophomore year, being required studies in the engineering courses and optional studies in the course in science and the woman's course. Advanced calculus is granted as an elective in the science course for the first term of the junior year.

In order to maintain the present standard in the higher mathematical studies, the admission requirementents to the freshman mathematical classes will need to be adhered to with great strictness. The student taking up the work of that year must not only be familiar with the general principles of algebra through equations of the second degree, but he must also be acquainted with their application to the class of examples such as are met with in the higher branches of the science of mathematics. To insure this, it will be of great advantage, even to those who have had considerable experience in algebra, to begin work at college in the spring term and enter the class in algebra of the senior term of the academic year.

The last biennial period has been one of special interest in the political economy section of the department. The general public desire for information concerning economic questions has been reflected in the large enrollment in the classes in political economy and the interest and enthusiasm shown in the work. Two terms are devoted to this subject. In the first, the student is made acquainted with the laws of production, the principles of money, foreign trade, tariff and taxation, the influences which affect exchange, and the various theories of distribution and consumption. In the second term, the history of economic development is studied. During the last year a special class was formed for the study of socialism. The class did excellent work, and the effect upon them of the thorough investigation of socialistic theories was most wholesome. Out of knowledge comes conservatism. It is to be regretted that the pressure of other duties will not permit a continuance of this class during the coming year.

But little has been done during the biennial period upon the subject catalogue of the economic section of the college library. Its completion is exceedingly desirable. In addition to being a great help in the department work, it can be used to good advantage by the college societies. Much of the work of these societies in debate is along economic lines. When the subject catalogue is completed it will furnish a ready means of referring to authorities, and will thus greatly increase the value of this portion of the library to the student body. The appropriation of $100 made by the board to the department for work of this kind will permit the employment during the coming year of a student taking the advanced course in economics, who can, under the direction of the head of the department, do much to advance the catalogue toward completion.

It will be noticed that the number of students receiving instruction in the department during the last year was 365. The entire cost of this department and of the secretary's office, including salaries and all other expenses, is less than $4,000 annually.

REPORT OF SANITARY AND PATHOLOGICAL DEPARTMENTS.

W. E. HARRIMAN, PROFESSOR.

I have the honor to report the general condition of two departments for the biennial period ending November 10, 1897.

THE SANITARY DEPARTMENT.

The college has passed through a most fortunate two years in the matter of health, no deaths having occurred at the college during the period. By economical management, the expense of the department has been kept within the fund accruing from the students' deposit of $1.25 per term. No serious epidemics have gained foothold among the students during this period. Measles appeared once, but the epidemic so common in the history of the college was confined to one case this year. Prompt isolation thorough disinfection, and fumigation associated with open warm weather, made control of the contagion possible.

THE PATHOLOGICAL DEPARTMENT.

This includes histology, pathology, physiology and therapeutics. The expense occurring in connection with these four studies has for the past two years been covered by a total yearly appropriation of $100. The students in pathology and histology are required to pay a laboratory fee varying from 50 cents to $1. The facilities for teaching in this department have not substantially improved during the present period covered by this report. Our present laboratory is not large enough, but it has, notwithstanding this fact, met the requirements fairly well.

DOMESTIC ECONOMY.

GERTRUDE COBURN, PROFESSOR.

Having had in charge the department of domestic economy during the years 1896 and 1897, I have the honor of submitting the following report:

The removal of the department in 1896 from south hall and its reestablishment in domestic economy hall were accomplished without considerable interruption of the class work, which was continued according to the course outlined in the college catalogue of the preceding year. Necessary repairing and remodeling being done, additional furnishings were planned, and purchases and accommodations provided for more and larger classes; so that, although not yet entirely painted and furnished, the rooms are now so convenient and adequate as to facilitate work in the household arts and sciences that is at once effective and enjoyable. The interest and counsel of your building committee and of the steward, Mr. J. F. Cavell, made possible in large degree the easy completion of this formative work, the expenditure for which was authorized, with the appropriation of $900, at your meeting in May, 1896.

To the course adopted before I assumed charge of the department, sewing (including hand and machine work, garment cutting and dressmaking,) had been added. The interest manifest in this work and the excellent results already attained are sufficient to encourage its continuance and extension.

The study of domestic economy was formerly given place in only the ladies' course, while many young women were classified in the science course. The arrangement has been so modified by thé committee on course of study that all women in the two courses are now expected to devote a part of their time during their first two years to this subject, and during the third and fourth years are allowed to elect to continue it.

To make the work more comprehensive or more directly effective other minor rearrangements have been made, and the plan outlined in the catalogue. The design is that the student having one lesson a week during six or more of her eight terms in college shall have the privilege of becoming intelligently and practically familiar with the subject of home-keeping; the location, construction, finishing, furnishing, lighting, heating, and cleaning of the house; the buying, keeping, combining, cooking, and serving of the food; the selecting, designing, making, and cleansing of the clothing; and the care of the personal health in all respects.

The numbers of classes and of pupils taught by me during the four terms have been as follows:

Year.	TERM.	CLASS,	Divisions.	SUBJECT.	Hours per week.	Number.
1896	Spring	Sophomore	4	Cooking	4	36
1896	Fall	Freshman	2	Cooking and hygiene	4	27
1896	Fall	Senior	1	Cooking	4	10
1896	Fall	Sophomore	1	Sewing	3	22
1897	Spring	Freshman	1	Sewing	3	21
1897	Spring	Sophomore	2	Cooking and hygiene	4	24
1897	Spring	Junior	1	Sewing	3	15
1897	Spring	Special	3	Cooking	3	66
1897	Fall	Freshman	2	Cooking and hygiene	4	23
1897	Fall	Sophomore	1	Sewing	3	11
1897	Fall	Junior	1	Sewing	3	11
1897	Fall	Junior	1	Cooking	3	7
1897	Fall	Senior	1	Cooking	3	7
				Total		220

Besides teaching these classes I have personally planned and arranged all of the laboratory work, selected and purchased the daily supplies, supervised the housekeeping, kept the accounts, conducted a considerable business correspondence, made a complete new card inventory, and prepared and delivered in different parts of the state three public lectures upon this department of the college instruction. In addition to their regular class work (which included the serving of about twenty meals each year to themselves and guests) the cooking classes have prepared and served the light refreshments at ten receptions in Margaret and Morrill halls, the average number of guests at each of which was about 100.

The current expenses of the department have been met by the annual appropriation of $300 for that purpose, supplemented by laboratory fees paid by the pupils for individual supplies actually used in the lessons. Aside from the purchase of cooking and sewing materials the large item of expense has been student help for housekeeping and janitor work.

Having had no assistant in teaching I have been unable to accomplish all the instruction desired for the classes, and Mrs. Irving W. Smith has kindly and most efficiently prepared the lectures and conducted the recitations in personal hygiene. This she has done without special remuneration.

In order to continue the work as at present arranged and to further enlarge its benefits, it will be necessary to provide another teacher for the department. This and other recommendations are made in detail in my annual report for 1897.

DEPARTMENT OF MILITARY SCIENCE AND TACTICS.

JAMES RUSH LINCOLN, PROFESSOR.

I have the honor to report the work in the department of military science and tactics to have been as successful during the past two years as it is possible to make it under the conditions existing. Without an armory it is impossible to drill in inclement weather, as our work must all be done out of doors. While we have a fine drill ground, much of the elementary work and, too, that of the greatest importance as to the set-up of the cadet, has to be omitted on account of the loss of so much time at the opening of our college year. We have no place indoors where a single company may be drilled, and the weather often prevents outside work being done. The state property is poorly cared for and much more is destroyed than would be with proper armory facilities for its care. We should have an armory at least 60x120 feet in size. This could be used also for a gymnasium, as is much needed also, and as an assembly room for such occasions, as our present chapel is entirely too small to accommodate the attendance. With a proper armory the military work could be made at least 30 per cent more efficient and useful. The school for officers of the Iowa National Guard, held at the college last January and February, required the use of an armory, but the work necessarily had to be theoretical throughout. This school could be made of great advantage to the state as well as to the guard. The order promulgating the rules and regulations for this school are herewith enclosed to show the character of work outlined. With a proper equipment this department of the college can be of great advantage to the state guard.

GENERAL ORDERS
NUMBER 28.

STATE OF IOWA,
ADJUTANT-GENERAL'S OFFICE,
Des Moines, Nov. 10, 1897.

The following regulations for the school of instruction for officers of the Iowa National Guard, are published for the information and guidance of all concerned.

BY COMMAND OF GOVERNOR DRAKE:

HENRY H. WRIGHT,
Adjutant-General.

REGULATIONS FOR THE SCHOOL OF INSTRUCTION FOR OFFICERS OF THE IOWA NATIONAL GUARD.

1. The school is officially designated, "The school of Instruction for officers of the Iowa National Guard."

2. The Commandant of the school shall be appointed by the Commander-in-chief.

3. There shall be a Secretary of the school, appointed by the Commandant.

4. The instructors shall be appointed by the Commander-in-chief, upon nomination by the Commandant of the school.

5. Officers, members of the student class, shall be designated in orders by the Commander-in-chief.

6. The school shall be governed by the rules of military discipline prescribed for the guard, and by the regulations of the school.

7. The Commandant shall make a report of the progress and wants of the school after the close of each year's session.

8. The secretary of the school shall be the custodian of the school records. He will be responsible for the school fund, for incidental expenses, and for all property purchased therefrom.

9. All official correspondence relating to the school, from members thereof, shall be addressed to the secretary.

10. The school shall be divided in five departments as follows:

First.—Department of Tactics.
Second.—Department of Law.
Third.—Department of Engineering.
Fourth.—Department of Hygiene.
Fifth.—Department of Strategy.

11. The Commandant shall assign the instructors to the several departments.

12. The departments shall embrace the courses of study as follows:

DEPARTMENT OF TACTICS.

Infantry Drill Regulations.
Manual of Guard Duty.
Small Arms Firing Regulations.

Infantry Fire and its use in Battle.
Service of Security and Information.
Organization and Tactics.
Lecture, description and use of the Horse.

DEPARTMENT OF LAW.

Military Law.
The Law of War.
Civil Functions and Relations of the Military.
Iowa Military Code.
Administration.
Troops in Campaign.

DEPARTMENT OF ENGINEERING.

Military Topography and Sketching.
Field Engineering.
Field Fortification.
Road and Bridge Building.
Signaling.

DEPARTMENT OF HYGIENE.

Selection of Soldiers.
Military Clothing.
Food and Alimentation.
Camps, Bivouacs, Marches.
Cleanliness, Exercise.
Disposal of Waste.
Drainage and Sewerage.
Construction and Care of Sinks.
Potable Water, Quality and Quantity. Chemical Examination, Common Impurities and Methods of Purification.
Ice, use of.
Preventable Diseases Common to Armies in the Field, and Precautions Against the Same.

DEPARTMENT OF STRATEGY.

Military Policy and Institutions.
Military Geography.
Logistics.
Staff Duties.
The Conduct of War.
Military History.

13. Recitations shall be classified as "Satisfactory" or "Unsatisfactory.' Each unsatisfactory recitation shall at once be reported to the commandant, who shall require an explanation in writing from the officer reported, and such communication shall be filed and preserved in the records of the school.

14. The study of text-books, and recitations therefrom, shall be supplemented by lectures and exercises in application. Recitations shall not, as a rule, exceed two hours.

15. Instructors shall report in writing, on the day of occurrence, all student officers late or absent from recitation or exercise, or for the neglect of proper preparation for the same; and such report must be filed with the records of the school.

16. All examinations must be written, except in Drill Regulations, which shall also include such exercises with troops as are possible, and all members of the class shall be given identical questions. In the case of an officer not examined with his class, owing to sickness or other cause, he shall be examined as soon as practical thereafter, as provided in orders; for this examination the topics and questions shall be similar to, but not identical with, those given in the general examination. The examination papers shall be filed with the records of the school.

17. The examiner shall assign to the student a mark on his examination papers, the mark varying between 0 for a complete failure, and 4 for a perfect paper. The average of the marks given in the several departments shall constitute the examination mark of the school.

18. To assist in fixing the relative proficiency of officers, the instructor in the department of Tactics shall note the manner in which students perform their duties in all military exercises. The ability to impart instruction, to command, to see what is required, and the soldierly bearing of an officer, all shall be considered in marking.

19. The values to be assigned to the different departments, in ascertaining the figure of merit, shall be as follows:

Department of Tactics, 4 { Practical work, 2.5. Theoretical work, 1.5.
Department of Law, 2
Department of Engineering, 3 { Practical work, 1.5. Theoretical work, 1.5.
Department of Hygiene, 1.
Department of Strategy, 2.

20. For record at the school, the classes at each session of the school shall be arranged in order of merit, special proficiency in any subject to be noted; but publication of the class standing shall be limited to an alphabetical arrangement in four grades, viz:

First.—Distinguished, mark of 4.
Second.—Proficient, mark of 3.5 and over.
Third.—Satisfactory, mark of 3 to 3.5.
Fourth.—Unsatisfactory, mark below 3.

21. Officers who pass successfully through the entire course of instruction, shall receive a diploma setting forth their proficiency. This diploma to be signed by the commandant, secretary and instructors.

22. Disbursements of the school fund, for incidental expenses, shall be made only upon the written order of the commandant, and vouchers shall be taken for all expenditures.

23. The authorized text-books shall be selected upon recommendation of the school staff and approval of the commandant.

24. Student officers shall be required to purchase their text-books.

25. Instructors shall submit to the commandant, at the close of each session of the school, any suggestions or recommendations they may have to make regarding the course of instruction and the text-books used in their respective departments.

RHETORIC AND LATIN.

MARGARET DOOLITTLE, PROFESSOR.

Rhetoric.—The course is the same as two years ago. The interest in the work is good, and the work itself thorough with a growing demand along the line of argumentative discourse and theme writing. Students in courses not including the more advanced rhetoric frequently take it as additional work. English is required to some degree in all courses.

The object of the first term's work is to familiarize the student with the principles of correct and effective expression. A knowledge of English grammar is required for entrance, but there is a practical review of the more important principles, including punctuation and capitals.

In this term special attention is given to clearness and aptness of speech; this involves considerable drill in the building of words from roots, and in the discrimination of synonyms. The work of the text-book is supplemented by library reference and lectures, together with a brief history of the language. Such written exercises as are practical are prepared and criticised.

During the second term (half year), all freshmen, except of the veterinary course, pursue the study with a view to an effective use of words and an appreciation of good literature. Preparatory to the study of literature later in the course, the principles of criticism are studied. The more important kinds of oral and written discourse are studied, analyzed, and produced. All written exercises are critically examined, and most of them returned to the student for further work. Oral and written reviews are so planned as to be both a test of matter learned and a drill in expression.

A large part of such work is done by outlines and lecture notes that require individual investigation of the topics in the library. The science courses and the agricultural course have rhetoric in the first half of the sophomore year. Here rhetorical analysis, a study of the laws and forms of thought and practice in debate and theme writing constitute the work.

Special Criticism.—The sophomores in the course for women and the science course write one paper each term, and the juniors and seniors in all courses write one oration each year. All these are carefully criticised and changes suggested.

English Grammar.—Preparatory students study English grammar the las-half of the year, *i. e.*, all the time that the preparatory department is in existt ence. Letter-writing and the simple kinds of discourse receive attention here.

Latin.—The work in Latin is not changed. It is studied two years chiefly as a supplement to the English language and to the sciences, and is therefore limited to the courses related to these studies.

DEPARTMENT OF ENGLISH LITERATURE AND HISTORY.

W. H. WYNN, PROFESSOR.

English Literature.—The aim is to secure in the mind of the student a growing interest in the "best thoughts of the best minds" in the artistic use of the mother tongue. To this end courses are arranged, varying from year to year, for the direct study of the works of the great masters of poetry and prose, accompanied by lectures and familiar talks, critical and bibliographical, relating to the times and influences, social and æsthetic, of the epoch under review. The student is required to reproduce the work of the class room, in a neat and satisfactory form, at the end of his course, and he is urged to devote as many hours to systematic collateral reading in the library as his time will admit.

The study is confined to the junior year, in the ladies' and scientific courses, three hours each week being given to it during the spring term and five hours during the fall term.

History.—In keeping with the practical aims of our industrial curriculum the courses in history are arranged so as to bear, in large measure, upon the life and history of our own American nation and the absorbing social and political questions of our own times. Beginning in the preparatory department, three hours a week are given to the thorough study of the elementary, or groundwork, history of the United States, which may serve as a basis for the special work that awaits the student in this line in the senior year.

The first term of the freshman year is devoted to the close study of the rise and development and fall of the Roman republic, in a series of lectures and class room papers, designed to illustrate the peculiar struggles of that great people in their experiment with free institutions.

The same course, essentially, is given to the young ladies of the ladies course in the first term of their sophomore year.

In the second term of the freshman year one epoch or more in English history is selected and made the basis of somewhat enlarged reading in the library or in standard works in English history of easy access to the student, the results to be gathered up in a note book subject to inspection when the work is done. Essentially the same work is required of the young ladies in the second term of their sophomore year.

The first term of the senior year is devoted to the history of the development of the United States. It has been found best in this study — a vein much worked at this time by eminent specialists of our own country in the formative periods of our history — to take up one or more of the decisive epochs and trace out the influences and causes, social, political and religious, determining the course of events.

The History of Civilization is the study pursued by the seniors in their second term. Inasmuch as the sociological treatment of this subject is still in its tentative stage, it has been thought best to put into the hands of the students, for thorough mastery, Guizot's History of Civilization, a book which is said "to have formed an epoch in the history of education," and concerning which an eminent authority has said: "Even at the present day, perhaps, no other historical book is capable of stirring more earnest or fruitful thought in a thoughtful student." This is supplemented with a brief course in the French Revolution, given in lectures, which the student is expected to follow up with researches in the library, and papers to be read in the class.

REPORT OF THE FRENCH AND GERMAN DEPARTMENT.

LIZZIE MAY ALLIS, PROFESSOR.

French.—French may be elected in the ladies' course in the junior year and in the first term of the senior year. By the unanimous request of the senior class, the study has been continued through the second term of the senior year. Three times the usual number of students began the study of French the present year—1897. Duffet's "French Method" is used as the text-book for the grammatical work. This is supplemented by conversation and dictation exercises. Particular attention is paid to oral reading and sight translation.

"Contes de Fees," Joynes; "L. 'Abbe Constantin," Halevy; "Fleurs de France,' 'C. Fontaine; "Le Misanthrope," Moliere; "Athalie," Racine; "Le Tour du Monde en Quatre—Vingts Jours," Jules Verne, are translated and carefully studied.

German.—German is an elective study in the freshman and sophomore years, in the ladies' course and in the freshman year, and first term of the sophomore year in the course in sciences as related to the industries.

So great has been the interest in German that every member of the sophomore class signed a petition to the faculty, asking permission to pursue the study of German a third year, and to take it as an "extra" study. The number studying German the present year of '97 is four times as great as last year. During the spring term the class commencing German was so large and composed of representatives from so many classes in college that it was necessar to divide the class, and to have two recitation periods for the freshman German. During the first term the student uses as text-book Thomas' "Practical German Grammar." Continued drill is given in the principles of declension, conjugation and syntax.

In the second term the grammar is completed and Bronson's "Stories by Grimm, Anderson and Hauff" is translated and used for oral and written composition work. This is supplemented by conversation, and as much as possible the recitation is conducted in the language taught. The second year is devoted to the works of Goethe, Schiller and Lessing, conversation and study of syntax being continued throughout the course.

ELOCUTION AND ORATORY.

ADRIAN M. NEWENS, PROFESSOR.

This department is now a department by itself. Heretofore, up to the year beginning 1896, the subject was under the supervision of, and usually taught by either the librarian or the teacher of music. The work has now increased to the extent of employing one person's entire time.

We are now pursuing a policy and a line of elocutionary work somewhat opposed to the schools of elocution and methods used by their graduates. The following sketch will serve to present our methods of study:

The entire freshman class (except the veterinary students, who have no work in the department at all, and the engineering students who take but one term), are required to take work in the department throughout the year. Their study consists of text-books and reading, with some recitation and composition work in the second term.

Throughout the junior and senior years a text-book is used more or less. but is discarded to give place to more practical work, that of the platform, Here the student presents to the class speeches of his own composition and preparation and those bits of literary and oratorical gems which may help in, and serve to illustrate, the power of public speech.

We work upon the principle that each man and woman has an elocution of his own, and as his personality speaks out in his address, we endeavor to build up HIS *talking powers*. He has the opportunity to master himself and others—his class—from week to week.

No *system* of gesture is studied at any time. The subject is not mentioned only in lectures and to individuals when they are capable of making such a means of expression supplement their recitations and speeches.

Extemporaneous speech is the subject of our attention during the last half of the senior year. This is the most valuable of all our work to the student because it is the practical application of all that which has gone before.

In the course for women the same general plan is pursued with some modifications. Physical culture drills are introduced in the junior year to satisfy a demand, and to advance the plan of work arranged for them. But throughout the course stress is placed upon good speaking.

Supplementary to all the work here outlined lectures are given on such subjects, as, public address, talking, conversation, extempore speech, art, general and specific, orations, literature and orators, etc.

ORATORICAL.

Each junior and senior is required to give one oration in public. These receive rhetorical criticisms and oratorical drill before they are given in public. It was a wise step on the part of the board of trustees who dictated the policy of public orations. This principle is involved, viz.: It is as important to be able to tell what one knows on any given subject in an interesting, commanding and persuasive manner as to know the thing itself.

College men will be leaders in local, sectional, state, and national affairs, whatever their occupation in life may be, and this work is sure to be of untold benefit to the students and graduates of the institution.

PRIVATE WORK.

Some special private students are taken where and when time and regular work permits. Students come to the college for special work of one, two, three, and four term courses. Many high school and sister college students come for coaching on orations and declamations preparatory to home, sectional, and state contests. The fact that these come to us for such drill is, modestly stated, complimentary to the general and specific work of the department.

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Eighteenth Biennial Report

OF THE

Iowa State College of Agriculture

AND THE

Mechanic Arts

INCLUDING

Report of Experiment Station

MADE TO

The Governor of the State

For the years 1898–99

PRINTED BY ORDER OF THE GENERAL ASSEMBLY.

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IOWA STATE COLLEGE OF AGRICULTURE
AND THE MECHANIC ARTS.
AMES, Iowa, December 1, 1899.

To His Excellency, Leslie M. Shaw:

In accordance with the statute defining the duties of the secretary of the board of trustees of the Iowa State College of Agriculture and the Mechanic Arts, I have the honor to transmit herewith the eighteenth biennial report of the board.

E. W. STANTON,
Secretary.

PRESIDENT'S REPORT.

To the Board of Trustees of the Iowa State College of Agriculture and the Mechanic Arts:

GENTLEMEN—I am empowered to present to you for his excellency, Leslie M. Shaw, governor of Iowa, and for the citizens of Iowa, the biennial report for the incoming general assembly.

OUR BIENNIAL PROGRESS.

It is gratifying to be able to report the most thrifty biennial period of any within the past ten years. The students in attendance, the deepened interest taken in the work by faculty and students, the investigations of the experiment station, and the enlarged heartiness of co-operation at home and abroad, make this a memorable period. We have been limited in funds but not wanting in enthusiasm, and have endeavored to make the most of what we had. The faculty have had heavy work, but have carried it on resolutely and successfully. The erection of a new carpenter shop met a most urgent need and did away with an old wooden structure that proved a menace to valuable property and a poor excuse for its purpose.

Long needed improvements were made in fitting laboratories for pathology and histology in agricultural hall; in fitting up additional portions of the main barn for stock and grain, and the erection of sheep houses; and in the painting of the main building, engineering hall, the dormitory cottages, and other buildings of the college. A farm dairy room has been provided in which are taught the most advantageous methods of practical dairy farming. The sewerage system has been extended to the dormitories, cottages, and other buildings. The sewage disposal plant is a success, and the sanitary condition of the entire college community is now placed in most commendable condition. Twenty-five shower baths for the young men of the college have been put in the main building.

But the most marked improvement has been in the teaching and the work of all the departments. The student organizations of the college have worked together most effectively and improvingly. The college classes have co-operated in most pleasing harmony. There has been no college scrap nor unruliness of sudents during the entire period. The courses of study have been greatly strengthened by the addition of an entire year to the courses of engineering, science for young women, and important additions to the courses in agriculture and veterinary science. As a consequence the students have increased in numbers, scholarship, and regularity of classification. Many persons wished their children to go to school more in the winter and less in the summer, so that the school year has been changed to begin about the first of September each year and close in June. This brings the college into line with the colleges of the country, both in arrangement of commencement and the reports of statistics and finance.

ADDITIONAL SUPPORT FUND.

Two causes have combined to make imperative demands for additional support fund. The rate of interest on the endowment-fund has decreased in the last several years from 8 per cent to 5 per cent. We had slight difficulty several years ago in loaning all of our endowment on farm mortgages at 8 per cent, but this year our money has accumulated on our hands beyond $100,000 because the law did not permit us to loan under 6 per cent. It will be necessary for the legislature to pass an enactment empowering the college to loan its endowment fund at 5 per cent. The decrease in interest has greatly curtailed the income of the endowment.

On the other hand the increased attendance in students has made extra demand for teachers. Ten years ago the faculty and instructors numbered twenty-five. This year they number sixty-seven. A number of our faculty and instructors have five and six classes a day, hour periods. This is entirely too much. A number of our classes have fifty to eighty students. This is too much for the most effective work. New classes will have to be formed and additional instructors employed. Our faculty as a whole are underpaid. In the last few years we have lost some very efficient teachers because of low salaries. We have on hand at present a most efficient faculty. They are devoted to the institution and enthused with the possibilities of the development and strength of the college. Frequent efforts are made upon the part of other institutions to secure a number of them. It is very poor economy to secure a strong faculty and allow it to be broken in upon by other states offering better inducements. The decrease in the income from endowment fund amounts to over $10,000, and in the end will reach $20,000. The increase of extra present demands for instruction and equipment amounts to $5,000. A very moderate estimate of the immediate enlargement of faculty is $15,000. This aggregates $50,000. For the present the board of trustees have unanimously agreed to ask for additional support fund of $31,500 per annum.

NEW ENGINEERING BUILDING.

By thoughtful educators and friends of education in Iowa it is acknowledged that this institution is the technological institution of Iowa. The original law of congress placed the engineering courses on the same basis with agriculture. The purpose of the law is to embrace all industrial education, not excluding liberal and classical studies. There is no disposition upon the part of our college authorities to make use of the privilege of embodying the so-called liberal studies in the curricula of the institution. It is the purpose and ambition of the college to build up a great technological institution, such as will be a credit to the state, an inspiration to the industries, and an honor to the nation.

The civil, mechanical, electrical, and mining engineering departments are all cramped and limited for lack of room. The civil engineering is in the mansard story of the old engineering building, and has very limited quarters for recitation, drawing, and laboratory room. Its laboratories are placed in the basement and in whatever location the generosity of some other department would allow.

The mechanical engineering department is lacking in recitation and drawing-rooms, is much wanting in rooms for machine shops and quarters for practical demonstration and experiment station in various lines of mechanical arts.

Electrical engineering and physics have been dependent upon another building for housing. They are much in need of recitation, laboratory, dynamo, and experimental rooms. The department has accommodated itself from cellar to garret in such rooms as could be secured, as a matter of necessity rather than from the standpoint of convenience and utility.

Mining engineering is in a similar condition, only more necessitous. This is the youngest department in the engineering division. The department has no quarters that it could call exclusively its own. It has been accommodated in Morrill hall, the physical and chemical building, and the engineering hall. It will need to be provided for throughout. For a number of months the college engineer, Professor Marston, under the direction of the board of trustees, and assisted by the counsel of the professors in the various departments, has, by visitation and observation, made a careful study of the leading engineering departments and buildings of colleges and universities in the United States and Canada. From experience at home and this observation abroad, it seems the most economical plan to have these four engineering departments in one general engineering hall. This hall will contain recitation, lecture, laboratory, office and museum rooms. In addition to this will be such minor rooms as would provide the building with first-class modern conveniencies and facilities. Before the advance in material this building could have been erected for about $100,000, but since the advance in building material, and the conclusion of the board of control and our college authorities that structures of this character should be fireproof, the estimated cost is increased to about $150,000.

PRESIDENT'S HOUSE.

The house which has been rented for the use of the president of the college has been sold during the biennial period. The college now has no suitable dwelling for the residence of the president. At present the college president must shift as best he can. The duties of the president require him to live near the college. The college is located a mile and a half from town, so it would be impracticable to have him reside in the town. A residence somewhat comporting with the dignity of the college and the office should be provided for the president. At a most reasonable estimate $10,000 would be a minimum sum. Illinois has recently put up a president's house at Champaign for $17,000. Other states have made provisions with a similar thoughtfulness.

HORSE BARN AND STOCK PAVILION.

The college has a long time been without suitable quarters for its horses. The only horse barn is a small brick stable of meager dimensions and poor provisions. We need a barn not only for the ordinary utilities of the farm, but also for educational purposes. This was the first college in Iowa to have a live stock room into which the living animal could be brought before the class, and the success of our young men in judging live stock is most eloquent evidence regarding the wisdom of that provision. But we have outgrown our present room and must have an annex room of larger dimensions This can be erected in connection with the horse barn. It should be an amphitheater of sufficient proportions to admit animals in group or single, as occasion may demand. A low estimate for this, including the stock annex, is $10,000.

PURCHASE OF PURE BRED STOCK.

The laboratories in practical agriculture and animal husbandry are the fields and the domestic animals of the field. To teach young farmers the fundamental principles and chief qualities of farm animals, you must have the living illustration before you. The father of John Ruskin used to take him over the country by carriage to visit the productions of the leading masters of art. When they would come to a gallery or a castle containing these masterpieces, the father always went ahead and selected out the best works of art and arranged so that the son could not see the poor productions. The father kept the boy looking at the choicest perfections of art, and that boy has been keeping the world ever since in search and admiration of the perfect and the beautiful in his chosen profession.

The animal interests of Iowa amount to millions of dollars annually. It is a small thing for the state to do to provide the best specimens of all breeds as models with which the youth can familiarize themselves for the direction of the best thought and production in the animals of our great commonwealth. Such an investment is neither a speculation nor an experiment. A large part of the success attending the work of animal husbandry in this college the past five years is owing to the weeding out of grades and poor stock, and the introduction of first-class animals in the various divisions of this department. Ten thousand dollars are asked for the purchase of pure-bred animals. These would represent cattle, horses, sheep, and swine.

SPECIAL TAX LEVY.

In asking for a tax levy of one-tenth of a mill for five years there is no disposition to pile up imaginary needs for the college. A candid view of the measures, buildings and equipment necessary for a healthy growth and development of the college in the next five years brings strong evidence of the necessity for such a provision. The sobering effect in this consideration is that after the amount of this levy should have been secured there would be quite a number of essential needs still lacking. I have carefully gone over with the heads of the various departments the present and prospective requirements in a reasonable fitting of the college in the next five years.

In the agricultural division there are needs for scientific experiments on road making, refrigerator plant for creamery, suitable quarters for animal husbandry, laboratory rooms for working, breeding, selecting and improving farm crops, laboratories and glass house for student research work in horticulture, additional facilities in dairying, animal husbandry, agricultural chemistry, practical agriculture, and the work of the experiment station, and permanent improvements of fencing, tiling, road making on the farm, in machinery and equipment and the different sections of farm work, and in improved lines of advanced thought in practical agriculture, the particulars of which it is wise to keep to ourselves until they can be embodied in completed outfits. From all these sources alone a cool estimate would aggregate $198,500.

In the engineering division the next five years disclose needs of urgent import. An enlarged equipment of all these departments is necessitous. Washington university at St. Louis, Mo., is putting in physics and electricity alone about $100,000 of additional apparatus. and the technological institutions of the country are increasing their equipment rapidly. Progress in the thought of physics and electricity is well demonstrated by the frequent and far reaching inventions of Edison, the wizard. In all lines of mechanical contrivances man's thought in the past decade has been unusually active and fruitful. To educate a young man for service in the mechanic arts he must be kept abreast of the thought in his calling. This necessitates extensive laboratories and a wide scope of illustrated materials.

We have asked several legislatures for machine shops, and this demand is still with us. With the general engineering hall secured much specific furnishing and equipping will be necessary. With the increase of 60 per cent in attendance of students in these departments the past year it will be necessary to provide additional facilities in materials as well as in teaching.

In civil and mining engineering special demand is made for clay working and experimentation in clays and building materials. And fitting for work of this character must be provided.

In geology there is a necessity for an early outlay in providing the departments with suitable working instruments and apparatus.

In mechanical, civil, electrical and mining engineering a moderate estimate, aside from the general engineering hall, would aggregate $200,000.

In the division of veterinary medicine the college has reached a period when a substantial enlargement is imperative. Veterinary science with the learning of the times has rapidly advanced in the past decade. Instead of a few veterinary colleges in the United States and Canada, quite a number of strong veterinary colleges have been established in recent years. In the next five years we must make provisions and suitable quarters for general hospital purposes, for a hospital of infectious diseases, for laboratories and histology, physiology, pharmacy and bacteriology, for dissecting room and crematory, and for shoeing shop. In addition to all this, it will be necessary to have the corresponding equipment of men and apparatus. An estimate of $75,000 is in moderation.

In the division of science and philosophy there are wants equally pressing. As soon as electricity and physics can be taken out of the chemical and physical building, the entire building must be remodeled and outfitted for general chemistry. This will cost not less than $15,000.

The department of botany has collections amounting to over $10,000, including the well known Parry collection, many things which, in case of fire, could not be replaced by any amount of money. The quarters of this department are limited and are practically without protection from fire. To place this department in commodious and safe environments is wisdom and economy.

In the department of zoology we have not adequate laboratory rooms, and must enlarge in some manner.

In domestic economy, of the rooms now occupied by that department is a question of present moment.

In English we are not able to meet reasonable demand for rooms and outfitting.

The library, which is considered under a separate head, is a vital factor in making up the wholesome wants of the entire college. It must have more space. All the departments of science and philosophy are in need of more room. Classes are multiplied already beyond a suitable capacity.

We are accommodating ourselves something like our forefathers, in the one and two-roomed houses of their primitive abodes. It is a good atmosphere for cordiality, but not so suitable for a plain reality, calling for more elbow-room and thought-room.

In military science there is a standing and eloquent argument for an armory.

Our college chapel has a seating capacity of 625. Our students more than fill the room. Our work is hindered in public gatherings and the general meetings of prime importance to the unfolding and enthusing of the college and friends with the larger thought and vision of lectures, assemblies, and general college occasions. These urgencies for a working outfit of building and equipment can be accommodated and fitted into each other so as to greatly diminish the aggregate cost, yet in five years $150,000 expended would be in the bounds of a considerate modesty.

In addition to this all there are general needs, such as the improving of the heating plants, the establishment of a poultry department, the enlarging of the college hospital, the providing for physical culture, and the promoting of the sanitary conditions of the buildings and campus. The levying of a special tax would enable us to select out of these respective divisions the things that could least brook delay, and plan more intelligently for the development of the material side of the college in the next five years.

SUMMARY.

Increase of support fund	$ 31,500
General engineering hall for mechanical civil, electrical and mining engineering	150,000
President's residence	10,000
Horse barn and stock pavilion	10,000
Purchase of pure-bred stock	10,000
Total	$211,500

One-tenth of a mill tax for five years for buildings, improvements, and equipment.

NATIONAL RECOGNITION OF THE IOWA STATE COLLEGE.

The last year book of the department of agriculture at Washington, D. C., gives some types of American agricultural colleges, and classifies them into three divisions, first, agricultural colleges; second, agricultural and mechanical colleges; third, universities having agricultural departments. The purpose of this treatment, as stated by Dr. A. C. True, the national director of the office of experiment stations, is "to describe briefly a few institutions, which may thus serve as types of the rest, and for this purpose institutions are selected which are relatively well equipped for agricultural instruction."

In the class of colleges of agriculture and mechanic arts this college is selected as one of the national types. Cuts of buildngs and interior are given, also a brief statement of the plant, equipment, attendance and courses of study. It concludes with the following encouraging statement for all the departments of the college:

> The Iowa college represents those institutions whose development has been along broad lines, and in which the agricultural course, maintained side by side with a number of courses in the arts and sciences, is being more thoroughly organized and specialized in accordance with the general advance movement in education along industrial lines.

THE LIBRARY.

The time has come when some radical aid should be given to the enlargement of the college library. The number of the volumes in the library is now 12,460. This includes the collection through the entire history of the college. The additions to the library of Cornell university, Ithaca, N. Y., for the past year were 13,744, more than we have in our entire library. In the choice of the library we have considered the experience of Emerson when he says: "I visit occasionally the Cambridge library, and I can seldom go there without renewing the conviction that the best of it all is already within the four walls of my study at home." But with the limited amount of funds at our command we are not able to add more than about 500 a year. At this rate it would take us 200 years to secure 100,000 volumes. The library is classified according to the Dewey system, and the catalogue is in two parts, the dictionary (author and title) and classed. Ten thousand dollars annually for the next five years would be a small expenditure for the enlargement of the library.

NATURE STUDY AND ELEMENTARY INSTRUCTION IN AGRICULTURE.

A number of the states, through the agricultural departments of the state colleges, have inaugurated a plan for the teaching of nature studies and elementary agriculture in the country schools. Most prominent among these is the state of New York. The New York legislature has appropriated $35,000 annually to the agricultural department of Cornell university for these purposes. With this money they have organized two bureaus, one including the work of nature study and a farmers' reading course, and the other investigations along such lines in different parts of the state. They publish leaflets treating of such subjects as "The soil—what is it?" "Tillage and under-drainage—reason why?" "The fertility of the soil—what is it?" "How the plant gets its food from the soil," and "How the plant gets its food from the air." They have about 10,000 farmers enrolled in the farmers' reading course. They have sent out about 600,000 pages of printed matter. Seven thousand names are on the mailing list for the teachers' leaflets. The aggregate of all these will reach about 25,000. Both cities and the country are taking the deepest interest in this movement. There is the tonic of nature in it to the teachers of the state, and the freshness of original truth for all the pupils. A summer school has also been established by the money thus given, divided in three parts—insect life, plant life, and the farm. The State College of Pennsylvania has a home reading course for farmers and conducts examinations in the subjects studied. This has been conducted successfully for seven or eight years. The year book of the United States department of agriculture says:

> Promoters of this movement believe that the most efficient means of elevating the ideals and practice of the rural communities are as follows, in approximately the order of fundamental importance: (1) The establishment of nature study or object-lesson study, combined with field walks and incidental instruction in the principles of farm practice, in the rural schools; (2) the establishment of correspondence instruction in connection with reading courses, binding together the university, the rural schools, and all rural literary or social societies; (3) itinerant or local experiment and investigation, made chiefly as object lessons to farmers, and not for the purpose, primarily, of discovering scientific facts; (4) the publication of reading bulletins, which shall inspire a quickened appreciation of rural life, and which may be used as texts in rural societies and in the reading courses, and which shall prepare the way for the reading of the more extended literature in books; (5) the sending out of special agents as lecturers or teachers or as investigators of special local difficulties, or as itinerant instructors in the normal schools and before the training classes of the teachers' institutes; (6) the itinerant agricultural school, which shall be equipped with the very best teachers and which shall be given as rewards to the most intelligent and energetic communities.

Iowa should not be behind in a movement of such practical moment and worth. God Almighty has predestined these Iowa prairies as an agricultural region. We occupy an unusual spot of the world. The legislature should enable the state college to inaugurate movements of this kind at once. The horticultural society of the state has made a beginning by the publication of leaflets bearing upon these questions.

It contains leaflets on "The Nature and Origin of the Soil;' "How a Plant Gets Out of the Seed;" "Plant Growth;" "How to Observe Insects;" and "A Nature Study Lesson on the Grasshopper" and "School Gardens." These leaflets were prepared by Professors John Craig, Pammel, Atkinson, and Summers of the college, Prof. James of Canada, and Miss Rogers of the East Des Moines high school.

BOARD OF TRUSTEES.

The statute of the last Iowa general assembly, making provisions for the governor of the state and the superintendent of public instruction as members ex-officio of the college board of trustees, has proved a wise and helpful measure. The experiences of these gentlemen in the public affairs of Iowa, and their relations to other state institutions, have made their services to the state college effective and desirable. By reason of serious and protracted illness, Mr. Addis Schermerhorn, of the Fourth district, has not been able to qualify nor meet with the board at any of its sessions this biennial period.

THE SALE AND PURCHASE OF PUBLIC LANDS.

According to the authority given by the last legislature the board of trustees sold off a portion of the northwest corner of the north farm and purchased the Kinsley tract of forty acres, that was mostly surrounded by the college farm on the north. This makes the location of the college farm lands more desirable and serviceable. A thorough system of drainage is now placed in the low lands of the remaining parts of the north farm so that this will be among the most productive portions of the farm. All these measures have contributed to the betterment of the land conditions for practical agriculture.

HON. JUSTIN S. MORRILL.

On December 26, 1898, the father of land grant colleges, Hon. Justin S. Morrill, passed to his eternal reward. In his distinguished services as a representative in congress for twelve years, and for thirty-one years a senator from Vermont, he bestowed himself the farthest and will be remembered the longest, as the author of the measure that established state colleges through the grant of public lands to the respective states and territories. The 14th of April, his birthday, at that time when all things are blossoming and everything that loves the sun is aptly out of doors will likely be a memorial day in the state colleges of America. A short time before his death he was asked for counsel by a board of regents, in regard to the scope of the land grant colleges, and said: "In reply, I have to say, that the act of 1862 was intended to give those whose lives were to be devoted to agriculture or the mechanic arts, or other industries, embracing much the largest part of our population, some chance to obtain a liberal and practical education. I enclose a quotation from the first act, the law upon the subject, which, you will see, did not proceed upon any exclusive idea, but indicated the leading purpose without excluding other classical and scientific education. You will see that it is very broad and liberal. I should hope that no farmer or mechanic would be so illiberal as to wish to have the monopoly of education in any of these land grant colleges. It will do the professional students good to be educated side by side with those who expect to obtain a living by labor."

MILITARY SCIENCE AND TACTICS.

The department of military science and tactics has for years been one of the most efficient in the country. The excellency of its work never stood out better than during the past biennial period. Many of the men trained in the college performed sturdy service in the Spanish-American war and in the Philippines. To hundreds who have not gone to war it has given a carriage of person, self-respecting discipline, and power of order vital to thorough education. A number of these have also identified themselves with the National Guard, and proved themselves worthy representatives of this thorough training. More than ever the department is in need of an armory for drill hall and the physical culture of our students during inclement weather. We have no suitable place for the storing of the arms. This request is not included in the askings of this year, but such a need makes itself felt more forcefully every year of our work.

THE DOCTOR PARRY BOTANICAL COLLECTION.

A working collection of botanical specimens is indispensable for carrying on botanical work. The Iowa state college is fortunate in containing an extremely valuable collection of plants made by the late Dr. C. C. Parry. This collection contains the types of many plants first found in the Rocky mountains as well as the Mexican boundary survey by the late Dr. C. C. Parry. In but a few cases are these types generally accessible, and in many cases these types can not be had except upon consultation with the collection at the college, so that these specimens should be properly preserved and kept out of the reach of fire. They are now maintained in a building which is not fire-proof, and in case of fire they would be entirely consumed. Several disastrous fires of this kind destroyed collections of great value in this country, and every effort should be made to preserve this collection. Although this collection was purchased at a cost of $5,000 five times $5,000 could not replace it. In fact money could not replace it. In addition the college has a valuable collection of plants made in the Rocky mountains, this state, and elsewhere in the Mississippi valley that should be preserved in a similar way. The whole collection should be stored in a fire-proof building. The capital invested in botanical collections alone amounts to $10,000. Outside of the collection of the Missouri botanical garden no other college west of the Alleghanies has so valuable a collection of early types as this institution.

NEW ARRANGEMENT OF COLLEGE STUDIES AND WORK.

The progress of the college work within recent years made necessary a more thorough system and division. The work of the college is now divided into four general divisions: the division of agriculture, the division of veterinary science, the division of engineering and the division of science and philosophy.

The division of agriculture is subdivided into five departments, practical agriculture, dairy, animal husbandry, horticulture, and agriculture chemistry. In connection with all of these departments the work of the experiment station is carried on, especially from the side of original investigation and observation.

The division of veterinary science includes twenty-eight courses bearing directly upon the science of veterinary medicine.

The division of engineering is divided into four departments, mechanical, civil, electrical and mining engineering.

The division of science and philosophy includes the courses of the sciences as related to industries, and letters and philosophy for young women. This embraces seventeen departments: mathematics, physics, chemistry, botany, zoology, geology, economic science, domestic economy, psychology and ethics, literature and rhetoric, elocution, Latin, modern languages, history, military science, music and library.

DIVISION OF AGRICULTURE.

The college has been fortunate in the arrangement of its course in agriculture so as to bring its students to the front of the most advanced standard of agricultural education, and at the same time meet the general demands of the public. In the department of practical agriculture there is afforded a field of educational culture and growth not surpassed by any other college on this continent. The connection of the experiment station with the college work gives a spirit of investigation and originality to the students in all departments of agriculture. The national government affords about $35,000 annually for this original work. The college shares its faculty and equipment with students who are preparing themselves in these departments of thought. The fields and barns and entire farm equipment become a great system of laboratories in which the young farmer is thoroughly initiated in the most advanced learning of this character. A room for live stock in connection with recitation is provided in agricultural hall, where various animals are studied from life and judged as to their perfections and imperfections.

DEPARTMENT OF DAIRYING.

In the department of dairying the long and short courses are patronized with a constantly growing attendance of students. Summer and winter courses of sixteen weeks each give facilities for those who wish to equip themselves fully for butter and cheese-making. A short winter course is given in January and February of each year as a review school for dairymen of this state who have already had experience. A laboratory in dairy bacteriology is established in the creamery building, in which questions arising from this side are carefully matured, by investigation and research, the results embodied in the operations of the creamery, and the scientific facts published free of charge. The graduates of the creamery have been very successful in securing positions. Representatives of this department in recent years have taken six first-class state prizes and gold medals, one second-place state prize, one first prize and gold medal of the National Dairymen's association, a first-class gold medal prize of the Chicago Butter association, and six first-class prizes and gold medals of state fairs, besides a number of first-class prizes in minor conventions and associations.

THE DEPARTMENT OF ANIMAL HUSBANDRY

Has made rapid strides during the past biennial period. The department now has good representatives of five breeds of horses, six breeds of cattle, seven breeds of sheep and six breeds of swine. These animals are used in class illustration and for experiment for breeding and feeding for milk and meat, as well as growth and maintenance. As the crops of the farm are in constant use for educational purposes, so all the animals are fed by rule and system, and the result of their management reported upon and used in class work. During the biennial period students of this department took first, second, and third prizes in the Interstate Live-stock Judging contest of college students at the Omaha Exposition in 1898.

THE DEPARTMENT OF HORTICULTURE

Is also taking on new thrift and enlargement. The raising and distribution of fruit trees and shrubs carried on so eminently by Professor Budd for a number of years, by his own suggestion, has largely given way to more exclusive questions of scientific horticulture. Prof. John Craig, the new head of this department, grew up in nurseries and horticultural work, as well as shared in a large measure in the development and advancement of scientific horticulture in the United States and Canada, being for six years in the Dominion Government station at Ottawa. A special horticultural library is now established in agricultural hall, composed largely of books presented to the department by the late Charles Downing, author of "Fruits and Fruit Trees of America," and the standard authority on pomology of to-day. The new greenhouse has made it possible to take up new questions along the several arts of gardening, and a special gardener is now employed for these purposes. In the lands devoted to the horticultural interests over 1,000 varieties of fruits, including the hardiest types of foreign and native lands are under constant experimentation, with a view to selecting the most serviceable types. Ample grounds afford operations on a large scale for the drilling of the students in grafting, budding and pruning.

OLERICULTURE

Is receiving more attention than formerly in this department. Leading types of vegetables are experimented with in the manner of culture and as to the excellency of product in order to acquaint the student thoroughly with this growing branch of industry in the west.

FORESTRY

Is receiving additional attention, part of the wooded land of the college farm having been set apart for park and forestry purposes. In this connection the planting of new trees, native and foreign, and observations upon those already in place for a number of years, are afforded, inviting facilities for this branch of knowledge so vital to the future of the public and private domains of America.

THE DEPARTMENT OF AGRICULTURAL CHEMISTRY

Is more thoroughly provided for than ever in the past of our college history, and yet was never so overcrowded as now. The chemistry of soils, the chemistry of field crops, and the chemistry of food products are receiving additional attention each year. Experimentation is also given in the chemical examination of milk, butter, cheese, processes of digestion, the various phases of food adulterations, and the questions of the formation and action of ptomains on the animal body. Additional laboratory room for the department of agricultural chemistry is imperative. The entire first floor of agricultural hall, or a space equivalent, will need to be given this department. In case the stock pavilion is voted by the legislature this very urgent extension can be secured the coming year.

DIVISION OF VETERINARY SCIENCE.

The young men who have availed themselves of the advantages of this course have contributed in no small degree to the advancement of the scientific knowledge and educational work of this specialty. Since the organization of the department as a school of veterinary medicine with authority to confer degrees, ninety-five young men have graduated from the course. Out of this number ten states have selected veterinary professors for their agricultural colleges, or state veterinarians, or have filled both offices from the same source of supply. Twenty-six have passed the civil service examination and received commissions for work in the United States Bureau of Animal Industry. The government experiment stations have drawn largely on our graduates for workers in their various veterinary sections, and they have made important contributions to investigation along other lines. Add to this the work done by the private practitioner, and it is but fair to say that this department has borne a conspicuous part in meeting the expectations of the lawmakers who planned and endowed the agricultural colleges of the country, and the demands of the live stock interest of our commonwealth.

The recent impetus given to the live stock interest by a notable increase in prices, especially of horse values, has created new interest in the minds of young men for this branch of science. Fifty special veterinary students received instruction during the present year, besides an equal or larger number from other courses of study in the college who came in for certain parts of the work.

While our equipments have enabled us to give to our students such training as I believe has unquestionably given them the front rank among veterinary graduates of this country, the fact still remains that we are sadly in need of additional facilities. In some branches the number of students is quite beyond the accommodations, and the work is seriously interfered with for want of additional room. This is especially true of the facilities for carrying on the work of dissecting, and conducting clinics, under such circumstances as will give to the student the best opportunity for seeing operations and profiting by practical demonstration. The department feels very sadly the want of a suitable building in which to conduct its practical operations along these lines, and I believe the need is so great, and the benefit to the most important industry of the state would be so important, that the very least the state could afford to do would be to provide the means of erecting such a structure.

DIVISION OF ENGINEERING.

In 1889 the division of engineering had sixty-six students, In 1899 it has 275. The attendance in this division increased 60 per cent the past year. In 1898 there were 176, in 1899, 275.

In addition to this, students of other departments are taking work in the division.

The headquarters of this department are in engineering hall, of which the first and second floors are given up to its use. The first floor is occupied by the office of the assistant professor of mechanical engineering and by the machine shops. The latter are in two rooms, having a floor space of about 3,000 square feet, one of the larger rooms having a portion creened off for a tool-room.

The second floor is occupied by the office of the professor of mechanical engineering, computing room, blue-print and dark room, recitation room and a large drawing room. The recitation room will seat about thirty students, and the drawing room has tables for fifty. Two hundred drawing boards and a considerable number of drawings, photographs and blueprints constitute the equipment of the drawing room. The recitation and drawing rooms have ample blackboard space.

The basement is given to engineering laboratory purposes, especially to experiment in hydraulics.

Besides the above space in Engineering Hall, the department occupies the power house, the pattern shop and the forge shop and foundry.

The machine shops are equipped with a 24x25 inch planer, a milling machine, a universal grinding machine, a shaper, a drill press, two emery grinders, a polishing wheel, a power hack saw, a cutting-off machine, eight engine lathes of capac ities from ten to twenty swing and three to ten feet between centers, and three speed and drilling lathes, together with the usual assortment of small tools in the tool-room. Power is furnished to this shop by an electric motor of five-horse power.

The pattern shop is a new brick building one story high, with spacious attic for storage of lumber. The building is 128 feet long by 38 feet wide. A tool room 12 by 20 feet is screened off in the center. A fire proof room is provided for patterns. The equipment of the pattern shop consists of a universal buzz-saw, a mortising machine, planer, buzz-planer, hand-saw, jig-saw, grindstone, fifteen turning lathes, benches for twenty students, twenty-four complete sets of small tools and a number of special tools. Power for this building is furnished by a twenty-horse power electric motor. By means of roller-bearings the line-shaft is made to consume only a small fraction of the available power.

The forge and foundry equipments are housed under one roof in a brick building 78 by 38 feet. A steel truss roof structure of substantial construction provides support for an overhead traveling crane, which serves the whole floor for handling heavy ladles, castings and forgings. Eight forges, with blower and exhaust fan, drill-press, vises, anvils, grindstone and small tools, such as sledges, fullers and swages, constitute the equipment for forge work.

A cupola and blower for melting cast-iron, a brass furnace, a core oven, core benches, eight sets of molders' tools, crucibles, and a large assortment of flasks are used for foundry work. A twelve-horse power gasoline engine supplies power for the forge and foundry.

The power-house contains the complete electric light and pumping plants of the college, all of which is available for experimental work, and constitutes a part of the engineering laboratory equipment of the engineering departments of the college. In addition to the above the engineering laboratory equipment of the department consists of a twelve-horse power Otto gasoline engine, a Wheeler condenser, three Worthington water-meters, a Holly duplex pump, injectors, weir and weighing tanks, gas-meters, a Crosby steam-gauge tester, fan-blowers for experimental work, Westinghouse air pump, a 100,000 pound Riehle testing machine, with Gray autographic device; a 50 000 pound Olsen testing machine, an Olsen torsion testing machine, a Thurston oil tester, a complete De La Vergne refrigerating machine, gas analysis apparatus, two Thompson, two Crosby and one Richards indicators, dynamometers, a Prony brake, platform scales, and some other apparatus essential and accessory to experimental engineering.

Students in mechanical engineering pursue the full course in shop-work, which consists of eight hours per week for four years. Partial courses are given to the students in the agricultural, mining and electrical engineering courses.

The system of instruction in the several shops begins with graded exercises calculated to familiarize the student with tools and with the materials used. The exercises are supplanted as soon as possible by work on machines or parts thereof which are to be put into actual use. By this arrangement greater interest is maintained in the work than would be possible with a strict adherence to the exercise system. The object of the shop work is not to teach trades, but to acquaint the student with the tools, materials, and difficulties of shop-practice, and to establish in his mind principles which will aid him in designing and construction work in the other studies of his course and in his professional career.

The drawing-room work begins with free-hand drawing and object drawing, and is followed successfully by machine sketching, mechanical and kinematic drawing, and designing. The latter division occupies the last two years of the course.

The object sought by the drawing-room course is to enable the student to make, as quickly as possible, neat and accurate working drawings, to design, in general and in detail, machines and parts thereof, and to apply throughout his knowledge of shop methods and his theoretical information acquired in the laboratory and class-room.

Experimental work begins with the junior year, and extends to the end of the course. The instruction in this subject is thorough, its scope being indicated by the following list of experiments. Tensile, transverse and compression tests of materials, properties of lubricants, measurements of power by absorption and transmission dynamometers, steam gauge and indicator spring calibration, flue-glass analysis, indicator practice, variation of engine speed, fan-blower tests, calorimetery, including throttling and separating calorimeters, weir and water meter calibration, efficiency tests of steam engines, boilers, injectors, and steam heating, electric lighting, refrigerating, power and pumping plants, and Hirn's analysis of steam engine, besides a number of special experiments in the line of investigation. The engineering laboratory work usually culminates in the thesis, which is an exhaustive investigation of a limited subject. From 400 to 500 hours of actual time are spent in thesis by students in the engineering courses.

In the current year the thesis subjects are:

The Effect of Clearance on the Economy of a Steam Engine.

Effect of Speed and Back Pressure on Economy of College Pump.

Economy Tests of Boiler Feed Pumps.

Investigation to Determine the Proper Division of Expenses of the College Power Plant.

THE DEPARTMENT OF CIVIL ENGINEERING

Furnishes thirty-three courses of study. It occupies the third story of engineering hall. The department also occupies considerable laboratory space in the rooms of the mechanical engineering department. Its hydraulic and cement testing laboratories are located in the basement of engineering hall.

The instrumental equipment of the department includes six transites, four levels, a plane table, two compasses, and numerous chains, tapes, rods, etc. The department is also well supplied with minor instruments, such as drawing instruments, field-glasses, computing machines, planimeter, etc. Additional instruments are to be purchased for use in the summer school of surveying.

Laboratory equipment includes stone sawing and grinding machinery, a drying oven, an abrasion testing machine, and a standard rattler for paving brick tests. In connection with the mechanical engineering department the civil engineering department owns an automatic and autographic Riehle testing machine of 100,000 pounds capacity for crushing tensile and transverse tests of steel, iron, wood, stone and paving brick. Students also have access to other testing machines.

The department possesses a complete cement testing outfit, consisting of a Fairbank's testing machine, a mixing slab, many briquette molds, cement and sand sieves, baths, etc.

A new hydraulic laboratory is just being fitted up. Water is supplied by about 700 feet of 8-inch and 10-inch cast iron pipe from the college elevated tank of 163,000 gallons capacity. The available head will be about 150 feet. Arrangements are made for measuring the loss of head from friction in the supply pipe and in its special castings. In the laboratory a tank is provided 50 feet long by 6 feet wide and 4 feet deep, which will be used as a measuring and discharging tank for the various pieces of apparatus, and which can also be used for experiments on the resistance of models to propulsion. The water will be removed from this tank by two sewers, one 6 inches and the other 15 inches in diameter. These are arranged to be used for experiments on the laws of flow in sewer pipes. The laboratory will also be provided with weir tanks, hydraulic motors, pumps of various types, apparatus for experiments with orifices, friction in small pipes, etc.

WATERWORKS AND SEWAGE DISPOSAL PLANT.

The department designed and supervised the construction of the college waterworks. The college water tower is the largest in this state and one of the largest in the west. The pumping machinery, which is of an unusual and very efficient type, is so arranged that college students in waterworks engineering can make tests of the efficiency of the apparatus as part of the class work.

The department has also designed and supervised the construction of the college sewage disposal system. This is the first sewage plant installed in the state. Investigations in the line of the most recent advance in sewage purification are now being conducted with the college plant, and it is hoped that the results will be of much value to Iowa cities in the future.

The waterworks system and the sewage disposal system are utilized so far as possible to furnish practical object lessons to the students in hydraulic engineering.

EXPERIMENTAL INVESTIGATIONS HELPFUL TO STATE INTERESTS.

The modern university or school of technology must serve the public in many ways other than by giving class instruction to students. Experimental and other investigations on important subjects must be carried on, and the results of these, as well as other important or recent truths of advanced thought or theoretical or applied science, must be made known to the general public, as well as to the institution's own students.

Realizing this the department of civil engineering is doing what it can to advance the interests of the state of Iowa by carrying on investigations helpful to state interests. One of the most important lines of work already begun is the testing of the properties of the building materials and paving brick of the state. Some results of this work have already been published, and the work is being systematically continued. It is hoped that this investigation will make the properties of Iowa building materials and paving brick better known, and so increase their use.

In future work in testing brick the department of mining engineering will co-operate, and the two departments hope soon to establish a joint laboratory, containing apparatus for making clay into brick and pottery, so that the clay deposits of the state can be studied and their use by manufacturers encouraged.

The experiments now in progress with the college sewage disposal system already mentioned constitute another line of work which will be very helpful to state interests, for many of our cities will in the near future find themselves compelled to cease polluting the streams of the state with their unpurified sewage.

Some of the experimental thesis work by students of the department has been of value in furnishing information useful to engineers. In one of these thesis investigations, made in 1898, nearly 200 photographs were taken, from which the exact paths of fire-streams from hose-nozzles under different conditions have been mapped out, giving information of value to hydraulic engineers. A few years ago two students made gaugings of the flow of sewage from the sewers of Des Moines, giving information which has since been made use of by sanitary engineers.

The department hopes to be able to make investigations along the line of Iowa good roads in the near future.

THE DEPARTMENT OF ELECTRICAL ENGINEERING

Furnishes thirty-one courses of study. This department aims to meet the needs of young men who have in mind the practice of electrical engineering in any of its applications in the business world.

The sciences of mathematics, physics and chemistry, and mechanical engineering are strongly emphasized, as it is believed they are of first importance in such a course. The attention of the student is directed to the value of these subjects and he is urged to give them his most careful consideration.

Mechanical engineering constitutes the practical basis for commercial electrical engineering, and in recognition of this the course in electrical engineering is largely identical with that in mechanical engineering. The mechanical engineering work required of students in electrical engineering includes mechanical drawing, shop-work, kinematics, machine design, analytical mechanics, hydraulics, materials of construction, engineering laboratory and the study of the steam engine.

Physics is the basis of the study of electricity and magnetism, the phenomena of which underlie electrical engineering, theory and design, and is manifestly of sufficient importance to demand considerable time and attention in the training of the electrical engineer. In addition to the work in physics prescribed for all engineering students, the electrical engineering student spends six to twelve hours per week in the junior and senior years in the physical laboratory and class-room. Laboratory work in electricity and magnetism, including work in the dynamo-room and testing laboratory, extends throughout the last two years of the course.

The first work in the physical laboratory embodies the accurate measurements of lengths, mass, and time, the adjustment and use of physical instruments, and the determinations of physical constants. In the laboratory course in electricity and magnetism the student makes a study of primary and secondary batteries and the electrical instruments of the laboratory, the determination of the constants of measuring instruments, and the methods of measuring the several electrical quantities.

The laboratory work in light and sound consist largely in photometric measurements of various forms of commercial lamps.

In the laboratory work of the senior year the more practical applications of the principles of electro-magnetism are studied, together with the principles of the magnetic circuit of current flow, etc.

The topics of electric wiring, power transmission, electro-chemistry, telegraphy, telephony, and electric signaling receive special attention in the latter part of the course. The laboratory work in these various topics is made to conform to the text-book and lecture work.

The study of alternating currents and alternating current machinery is taken up in the senior year. In the class-room work much stress is placed upon the theory of alternating currents, and in the laboratory the student is afforded opportunity to study and familiarize himself with the phenomena peculiar to such currents.

The department possesses thirteen experimental dynamos, including two arc machines, one 250 light Diamond alternator and one two light Pony alternator; also one twenty-five-horse power M. P. Ahlms-Edwards direct-current motor and other series; and shut wound continuous current machines. There are also transformers of various types, and a secondary battery of fifty cells.

In addition to this equipment the student has access, for experimental and test purposes, to the electric machinery of the college power-house and lighting plant. Among other machines in this plant are two fifteen K. W. Edison dynamos, one four-pole eighteen K. W. compound-wound generator by the American Engine company, and one 500 light alternator. There is also a series of motors for driving the machinery of the mechanical engineering department, which range in size from five to twelve-horse power, and which are also available for test purposes.

In addition to the general physical laboratory rooms, the department occupies seven basement rooms in the west cottage.

An extended system of wiring connects all rooms of the department with the switchboards of the dynamo laboratory and the apparatus room. At these switchboards are the terminals of a line connecting with a 110 volt, 150 ampere directing current machine, which is available as a current source during the day. During the evening hours there are available 110 volt direct or alternating current circuits.

THE DEPARTMENT OF MINING ENGINEERING

Affords seven different courses. Some one has said that utility is the bane of science, but a greater man has written that philosophy is never more exalted than when she stoops to minister to humanity. Engineering is eminently practical in its varied phases, and thus commends itself to those interested in the material welfare of the community and the development of the natural resources of the state. This is no less true of mining engineering than of the other branches of engineering. The mineral output for Iowa has been steadily on the increase, and in 1898 the total product exceeded $7,475,000, firmly establishing mining as one of the most important industries of the commonwealth. While this comfortable sum was won from nature's rock-bound stores, no one would pretend to say that the natural resources of the state were developed to their full capacity. The coal output is on a low up-grade, and yet nearly half of the state draws its supply from the coal fields of Illinois and Indiana. The lead and zinc interests have remained practically at a standstill for a score of years, chiefly for want of intelligent direction. The quarry products of the state have been displaced largely by importations, from other states, of stone, no better in quality, but produced on a more economical scale; while her clay interests are but in their infancy. All of these great industries require, for their best development, educated, intelligent direction. Old ways and wasteful methods must give way to new processes and improved machinery. The skillful hand must be supplemented by the educated, resourceful brain in order that products of the mine, the quarry and the pit may meet in successful competition similar products from other states.

In 1894 the Twenty-fifth General Assembly, realizing the necessity of supplementing practice with science in order that Iowa might assume her proper place among the mineral producers of the nation, legislated as follows:

CHAPTER 107.

AN ACT to establish a school of mines for the state of Iowa.

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF IOWA:

SECTION 1. There is hereby created and established a school of mines for the state of Iowa, which shall be a department of, and under the control of, the State Agricultural college.

SEC. 2. It shall be the duty of the board of trustees to provide for a thorough course in theoretical and practical mining, so as to fit the students to undertake the full management of mining in its different branches.

SEC. 3. Students shall be allowed to enter upon the same conditions, and shall be accorded the same privileges, as other pupils of the State Agricultural college.

Approved March 30, 1894.

To carry out the will of the legislature as expressed in the above act, two courses in mining engineering are offered. The first is intended for those students who desire a "thorough course in theoretical and practical mining" and underlying sciences, and requires four years for its completion, leading to the degree of bachelor of science in mining engineering. The requirements for admission are the same as those for admission in other engineering courses. Students who pursue this course to completion are expected to be able to undertake the "full management of mining in its various branches," at least as practiced in Iowa, and to become familiar with the principles involved and the methods employed in good mining engineering practice in general.

The second is specially adapted to men actively employed in the mining industry, but who have neither the time nor the opportunity to prepare themselves to meet the entrance requirements for the regular four years' course. It is intended more particularly for mine superintendents, mine foremen, and the more intelligent miners who wish to gain some insight into the laws of mineral origin, accumulation, and distribution; the most economical and approved methods of winning the ores, the fuels, and the structural materials from nature; the mechanics of the steam engine and of the dynamo and their manifold applications to mining and the principles involved in mine surveying, mine drainage, and mine ventilation; in short, to acquaint themselves with the science of mining.

EQUIPMENT.

The department of mining engineering is located in Morrill hall, dividing quarters with the department of geology. The description of rooms, collections, and apparatus which may be found under the latter department will apply almost equally well to mining engineering. In addition to the apparatus previously listed and described, the department is supplied with a Sullivan core-drill, with a complete set of tools and accessories for actual field operations; a sensitive six-dial, anemometer read to 10,000,000 of feet and adapted for the measurement of currents of air through mines and tunnels — an instrument absolutely necessary in order to deal intelligently with the problems of mine ventilation; a miner's level with rods and measuring tape; a plane table with accessories; a set of miner's tools; a barometer, clinometer, and various instruments used in ascertaining distances.

The proximity of Ames to the Iowa coal fields affords easy access to the coal mines at Boone and Des Moines. The great centers of the clay industries — Des Moines, Boone, and Ft. Dodge — are equally accessible; while the quarries of Marshall county are scarcely more than an hour's ride from the college. These and numerous allied industries are, after all, the most important and indispensable laboratories for the practical mining engineer. The department undertakes to present the accepted theories concerning mineral aggregation, origin, and occurrence, but these theories can only be put to the test by an intelligent use of the drill, the level, and the plane table. The accredited methods of winning the ores and minerals receive full discussion of the class-room, but only render obvious the necessity of becoming familiar with the practical workings of the sluice-box, the tipple, and the stamp-mill. The chemical and physical properties of a clay may be ascertained in the laboratory, but a complete knowledge of its properties and its proper mode of treatment can only be gained by following it from the pit to the street. In short, the department aims to give as complete an exposition of the theories and laws which underlie the science of mining, as the time will permit, but the verification and application of these theories and laws must be made, in large measure, in the field and in the industries.

DIVISION OF SCIENCE AND PHILOSOPHY.

The national law establishing land grant colleges makes special mention of teaching science in relation to the industries. The college holds closely to this original intent of the law. Fourteen courses are given in the department of mathematics, twenty-eight courses in the department of physics, seventeen courses in department of general chemistry, sixteen courses in department of botany, eleven courses in department of zoology, nine courses in department of geology and mining, three courses in department of economic science, nine courses in department of domestic economy, two courses in department of psychology and ethics, sixteen courses in department of literature and rhetoric, eight courses in department of elocution and oratory, nine courses in department of French and German, four courses in department of history, and eight courses in department of military science and tactics. The department of music is chiefly self sustaining. It meets a large demand upon the part of many persons who wish to take some studies in instrumental or vocal music in addition to the other college courses of instruction.

The course in letters and philosophy is given only to the young women of the college. This is done to avoid conflict of interest with any other state institution. Young women are privileged to take studies in any department of the college. Quite a number of them now pursue studies in science and a few studies in agriculture and engineering.

DOMESTIC ECONOMY.

The department of domestic economy has made very encouraging growth the past two years. The courses of study have been enlarged to include plain sewing for young women in the freshman year, including lectures upon fabrics, tools, and manufactures employed. This work also provides sewing for advanced classes. Dressmaking is taught, in which the young woman is taught the designing and making of her own garments. The courses in cooking and hygiene have been increased. In all, this department now affords nine different courses of study and instruction for young women. The first two graduates in this department secured desirable positions in Boston, Mass., before their work had been fully completed. An additional instructor has been added for this work and the equipment of the department increased.

THE WORK OF THE IOWA EXPERIMENT STATION.

The establishment of experiment stations by our national government is something unique in the history of education. There are now sixty-four colleges receiving the benefits of the land grant and Morrill acts of the United States government. In these are fifty-four agricultural experiment stations, having a total income of over $1,000,000, per annum. These institutions employ a working force of about 650 persons, whose time is given to administration and research work upon all the modern phases of scientific agriculture. They publish over 400 bulletins annually, and these are sent free to over half a million of American farmers. These bulletins comprise more than 16,000 pages of scientific and practical matter bearing upon live questions of soil, crops and animals. In addition to these publications of the states, the department of agriculture issues special farmers' bulletins, of marked scientific value, at the rate of over 2,000,000 copies a year, and the year book, of the national department, of 500,000 copies, and containing the ripest thought at home and abroad, and distributed among the farmers of the United States. The demand for this literature is so great that the department has not been able to keep fully up to it. The total number of all publications of the national agricultural department has increased in the five-year basis at a rate of 160 per cent. There are 5,500,000 farms in the United States, and the national government bids fair to reach all these farms in the early future with the most helpful literature in the everyday problem of the furrows. Of this money the Iowa experiment station now shares about $35,000 a year. It has taken up as rapidly as possible the investigations of problems in soils, field crops, fruits, foods, animals, dairying, insects, plants and the multifold economic and practical questions of modern agriculture.

In the biennial period the station has issued bulletins 37 to 43 inclusive. No. 37 contains sugar-beet investigations and especially sugar-beet growing in Iowa. One thousand five hundred pounds of seed were distributed in one year to various counties of the state, and about 1,200 samples of the beets analyzed. The results are tabulated by counties and the conclusion reached that the greater part of Iowa is favorably situated for profitable sugar-beet production. The sugar beets grown in the experiment grounds at the college have always ranked higher in richness and purity than those grown in other sections of the state. The superiority has doubtless been largely due to the exercise of more care in preparing the ground and cultivating and growing the crop. Aside from this the conditions prevailing on the college farm are not more favorable than those common to other localities. A wide variety of soils respond favorably to the growing of sugar beets, and any fairly good soil that will grow corn or potatoes will produce beets successfully. The expense of growing the crop will not exceed $2 a ton. A large part of the success of the work depends upon the preparation of the ground and the cultivation of the crop. The raising of beets contributes to better farming of other crops and helps greatly as a food to live stock.

The people of Iowa pay out $16,000 a day and $6,000,000 a year for sugar. Here is a possibility for the developing of new and profitable resources for our people.

Bulletin No. 38 treats of the Russian thistle, giving an account of its origin, introduction to the United States, its present general distribution and Iowa distribution, character of the plant, and the methods of its extermination.

Bulletin No. 39 treats of the weeds of cornfields. A weed, in the ordinary acceptance of the term, is a plant growing where it is not wanted. All plants except corn and the accompanying crop, pumpkins, must be considered as weeds. A number of weeds are largely troublesome because they rob the soil of a number of necessary food elements, and by shutting out the light prevent the crop from making the greatest amount of food. The ragweed and mustard belong to such a class. Other weeds, like the germander, prevent the growing crops by a networking of roots that interfere with the full development of the roots of the grain crop. Corn being a cultivated crop is more largely interfered with than most other products of the field. These weeds are classified as European, like the prickly lettuce, pig grass, foxtail, bindweed and bull thistle. Others are southern weeds, like the cocklebur, Indian mallow and horse nettle. These flourish mostly in the southern borders of Iowa. Another crop comprises the western weeds, like the buffalo bur, and the cream weed, more common in eastern Iowa. Still another class is that of northern weeds, like the marsh elder. This is spread along the Missouri and northeastward across Iowa. Smartweed belongs to this class The duration of weeds as annual, biennial, and perennial is noted.

A study is given to the most troublesome weeds of the cornfield. They are classified as worst, bad and indifferent. The most conspicuous weeds are described, for the practical study and knowledge of the farmer. Methods for the destruction of obnoxious weeds are given.

Bulletin No. 40 bears upon the relation of acid fermentation to butter flavor and aroma. The market value of butter is largely determined by its flavor. This counts against it quicker than mechanical conditions. The score cards of dairy associations generally assign 45 to 50 out of 100 points to the flavor. It is very difficult to secure a uniformly high flavor. There is no agreement as to the chemical nature of the substances which give the delicate flavor and aroma to butter. It is accepted, however, that the flavor substances, whatever they may be, are products resulting from a breaking down of the milk and solids, and that they are the results of the growth of bacteria. While the feed of animals yielding milk has some influence on the color and hardness of butter, yet this influence is less than the effect of the fermentations which have taken place in the milk and cream. While undesirable feeds, such as turnips, carrots, and certain wild plants and weeds may affect the flavor of the milk and the butter, yet undesirable fermentations may produce a flavor worse than any of these. The difference between the flavor of winter and summer butter is somewhat due to influence of feed, but much more to the difference in kinds of fermentations which are in the milk. Experimentations were made with bacillus subtilis, a growth arising in connection with hay. The ripening of cream came in for careful observation and experimentation. A comparison is made between the relative number of bacteria in unripened and ripened cream and milk. A study was made of the difference between winter and summer flavor and an examination of natural starters. Butter flavor, from pasteurized cream ripened with acid producing bacteria, is included in the investigation. Conclusions were reached as follows:

> Butter flavor is produced mostly by the bacterial fermentations which have taken place in the milk and cream. The kind of flavor produced depends upon the class of bacteria causing the fermentation. Cream ripened with common bacteria found in hay dust (Bacillus subtilis) gives a very undesirable flavor to butter.
>
> The general superiority of butter flavor in the summer season is mainly due to the difference in the fermentations that are in milk.

This difference is due to the greater number of bacteria of the acid class found in the milk during the summer season.

The ripening of a good quality of natural cream is mostly a development of acid bacteria. When good-flavored cream is ready for churning, the number of bacteria per cubic centimeter varies from 280 million to 3 billion. Of this number the acid-producing bacteria constitute from 91 to 98 per cent. As the process of ripening advances, the relative per cent of acid bacteria greatly increases. As this proceeds, some species disappear; others are prevented from increasing in numbers.

A good natural skim milk starter is practically a pure culture of acid producing bacteria.

The flavor-producing power of four species of acid-producing bacteria was tried by using to ripen pasteurized cream. Any one of these give the butter the typical flavor and aroma produced in natural ripening.

The most common milk souring organism (Bacterium lactarii), all things considered, gives the most satisfactory results of any of the species tried as a culture for ripening cream.

Practical experience and experimental evidences both indicate that the most important factors in cream ripening are the development of the typical acid fermentations and the elimination or suppression of other and injurious types of fermentations.

Bulletin No. 41 gives reports from trial stations on new orchard fruits and shrubs. This embraces the testing of orchard fruits, ornamental trees, and shrubs of a period beginning with 1878 and extending to the time of the report by Prof. J. L. Budd. It includes various varieties of apples, cherries, and peaches, ranging in testing grounds over portions of Canada and the United States. The report also contains data regarding ornamental shrubs and trees introduced from eastern Europe in 1883.

Bulletin No. 42 deals with the horse nettle as a troublesome weed in Iowa, with the European bindweed or the morning-glory, the ground burnut, and with the potato scab. Many complaints have come to the station in regard to the horse nettle. A description is given of the plant, an account of its distribution in America, and the manner of its extermination. The smothering or cutting off of leaves of the plant is the most effective method for its destruction. A crop of rape is helpful in smothering it out, while the hoe and plow can be used effectively in its extermination. Similar methods can be employed in the eradication of the horse nettle. The ground burnut is a comparatively newcomer among the weeds of Iowa. It appears chiefly on the island of Muscatine. Its spiny burs would prove very troublesome to stock, and its spread should be prevented.

Chemicals and the rotation of crops over a period of six or seven years are the most preventive measures of potato scab. Particulars are given in the bulletin.

No. 43 is entitled, "Some Injurious Scale Insects." This bulletin is prepared in response to inquiries regarding insect pests. Scale insects are bark lice, and are found in varying degrees in the orchards of the state. Fortunately Iowa nurseries and orchards have thus far been kept free from the San Jose scale. The manner of treating and preventing the ordinary scales that inflict the trees of our regions is given. Description and instruction regarding the dread San Jose scale are embodied in this bulletin. It concludes with directions in the use of insecticides effective in exterminating scale insects.

STATE AID FOR THE SUPPORT OF THE EXPERIMENT STATION.

In addition to the $15,000 annual appropriation by the national government for the support of an experiment station in each state, a number of the states have made additional appropriations for the enlargement of the work of the stations. Some states have gone so far as to enlarge the work of original investigation in addition to that of the national experiment station, but that is generally where the geographical extent of the state would require experimentation to be carried on in different localities. There is no such a demand as this in Iowa, but the time has come when Iowa ought to add to the income of the experiment station in order to meet a growing interest and demand for original investigation on a still more extensive scale. Much more printed matter of chief importance to the whole commonwealth would be distributed more fully through such aid. Careful attention to this eloquent need is asked.

CRITICAL PERIOD.

This is a critical period in the history of the Iowa State College of Agriculture and the Mechanic Arts. The balancings of this crisis rest with the incoming legislature and the people of Iowa. We never can expect to present any better spirit of study, faculty, and friends with more united front upon the part of all our workers. We hope to go on in this spirit. But that progress rests in a large measure with this legislature. We are in a period of unusual thrift in buildings, equipment and material appliances in American education. In 1898 $13,000,000 were donated by private benevolences to schools of learning in America. In 1899 $20,000,000 were granted from similar sources. In eight years the University of Chicago, in equipment and endowment, has secured about $9,000,000. The legislatures of the leading states east and west in recent sittings have made largely increased appropriations for their educational institutions. Where Iowa is spending $1 for educational purposes, they are spending from $3 to $10. In Illinois the last legislature appropriated $150,000 for an agricultural hall. To the south of us Kansas appropriated $35,000 for a dairy building; and so on around, states are advancing the material equipment of their educational forces in a threefold more rapid pace than hitherto.

As a college we have suffered by waiting four years without adequate appropriations for buildings and equipment. We have wrought our best to present to the people of Iowa this college in its present condition. With utmost goodwill to all the institutions of the state, we ask for the largest appropriations in our history in truest sincerity and according to our best judgment. These material improvements and resources for education in America will give way in the immediate future to a general upheaval in methods of teaching, in strengthening of faculties and in promotion of the educational welfare of the states and the country. In order for Iowa to do her share and to be true to her own youth, prompt action and liberal provision must be made for the Iowa State college. There is a proverb, whose origin I do not know, It is "God's pity;" but it would be a pity fit for gods to check this work in its upward and onward growth by meager appropriations. A few hundred thousand dollars now and the enactment of a tax levy will amount to but half pennies for our people as a whole, but when centered in the development of this college will bring untold magnitudes within the next ten years into the youth and all the commonwealth of this beloved Iowa.

WELL-MEANT OBJECTION

Is sometimes made to the making of comparisons with the institutions of other states. Anything human that grows must compare. Comparison is at the foundation of ideas and progress. A lone idea in a brain or a college would encyst. The educational progress of the United States owes much of its rapidity and maturity to a comparison with the leading schools of the world. Iowa owes much of its excellent educational system to the comparisons of Horace Mann and the standard of Massachusetts. The elaborate report of the board of control regarding the future needs and present excellencies of the state institutions under their management, owes much to their statesmanlike observation of similar institutions in other states. A man never knows what he has at home until he knows what there is abroad. For these reasons, as managers of state institutions, we are compelled to make comparisons. The recognition of the national government as to the scope of the courses of study and the successful interfitting in this college of the branches embraced in the land grant act of congress in 1862 is encouraging. It now remains for the good people of Iowa to make possible the unfolding of the work herein wisely outlined.

THE NAME OF THE COLLEGE

Is in full The Iowa State College of Agriculture and the Mechanic Arts. In the brevity of general usage Iowa State College is employed. These terms are just to all the departments of our college work. There is no disposition to sell agriculture for mechanic arts nor mechanic arts for agriculture. The college is as much mechanical as it is agricultural, and as much agricultural as it is mechanical. The statement by parties now and then that "agricultural" would catch the farmers is beneath honest consideration, and such a spirit would betray weakness in every particular. The farmers of Iowa, as well as we, have more sense than this. The national law governing colleges is now more fully understood by the American people, so that the chief purpose is what can be gotten out of these colleges for the good of all the people rather than what we put on them or in them merely in name. There is only one purely agricultural college in the United States, that at Amherst, Mass. All other colleges of this character are either colleges of agriculture and mechanic arts or departments in state universities. In the southern states the "A. and M. A. college" is a favorite term, referring to agriculture and the mechanic arts colleges. The year book of the national agricultural department at Washington, on the naming of these colleges, says:

> To do this in any satisfactory way is by no means a simple matter. The colleges of agriculture in the several states and territories have been so fashioned by the conditions of their local environment that each of them has developed individual peculiarities of form and life to such an extent that classification of them is more or less open to objections. It will not do at all, for example, to classify these institutions according to the names

which they bear. Some which are denominated simply agricultural colleges are really institutions of complex structure, while others, in whose title the term "agricultural" does not appear, have thoroughly organized and well attended courses in that branch of learning.

The problem of ends and departments is easily solved upon the college campus at Ames. The students of the departments of agriculture and mechanic arts mingle with mutual respect in literary societies and all the social interchange of college life. The young engineer or scientist is the better for his contact with the young agriculturist, and the young agriculturist is the stronger for his growing up with the other two. In fact, the larger per cent of all these departments are young people from the farms and rural villages of Iowa, and those from the cities find that the sterling worth of the furrow is a wholesome equivalent to the urbanity of the paved street. So that the term Iowa State college is but an honest conviction and expression of fairness to all the departments of the institution. That means Iowa, both country and town, is back and for the young educated farmer, mechanic, or student of any course in the Iowa State College of Agriculture and the Mechanic Arts.

Acknowledgment is hereby made to all the authorities, associates and friends who have made possible and real the wholesome growths and attainments of this eighteenth biennial period. With the deepest good will to all other institutions, state and denominational, this report is submitted in earnest hope of our Iowa people becoming still more intimately acquainted with the needs of agricultural, technological and industrial education in their state college at Ames, and the full-faced, whole-handed, one-hearted plea for more money, to be free and to grow. Very respectfully submitted,

W. M. BEARDSHEAR,

President Iowa State College of Agriculture and the Mechanic Arts.

FINANCIAL REPORTS.

TREASURER'S REPORT.

The following is a complete statement of the transactions in all the accounts for the fiscal year ending June 30, 1898.

	BALANCES, NOVEMBER 11, 1897.		FISCAL YEAR.		TOTALS.		INTEREST FUND.		MORRILL SUPPORT FUND.		BALANCES, JUNE 30, 1898.	
	Debit.	Credit.	Debit.	Credit	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.
Interest on lands belonging to to Congressional grant		$ 4,981.82		$ 2,374 83		$ 7,356 65		$ 7,356.65				
Interest on accumulated interest				6,038.48		6,038 48		6,038.48				
Interest on investment of endowment fund				23,027 81		23,027.81		23,027.81				
Interest on lands obtained by foreclosure				168 50		168.50		168.50				
Endowment land purchase fund			$ 2,000.00	2,000.00	$ 2,000.00	2,000.00						
Contingent principal fund		83,680.00	24,105.00	4,425.00	24,105.00	88,105.00						$ 64,000.00
Mortgages receivable	$ 81,150.00			17.150.00	81,150 00	17,150.00					$ 64,000.00	
Donation fund		9 60	159.57	178 80	159 57	188.40						28.83
Diploma fund		904.33	104.57	25.00	104.57	929.33						824.76
Room rent		370 98	871.86	1,207 05	871.86	1,578 03						706.17
Railroad damages		88 00				88.00						88.00
Personal accounts	476 95				476 95						476 95	
Bills receivable	577.25				577.25						577.25	
Morrill support fund		8,989.88	13,635.83	8,000.00	13,635.83	16,989.88				$ 3,354.05		
Salaries			8,397.94		8,397.94		$ 8,397.94					
Farm department			5.749 69	3,863 93	5,749 69	3,863.93	1,885,76					
Creamery			11,548 53	11,797.31	11,548.53	11,797.31		248.78				
Dairy			1,504 12	723.07	1,504.12	723 07	781.05					
Horticulture			1,469 67	2,435 53	1,469 67	2,435.53		965.86				
Chemical department			1,426 08	424.37	1,426.08	424 37	1,001.71					
Civil engineering			559.64	5 86	559.64	5.86	553.78					
Entomology and zoology			662 85	43.71	662.85	43.71	619.14					
Mechanical department			4 524.13	1,759 49	4,524.13	1,759.49	2,764.64					
Physical department			776 91	160 43	776 91	160.43	616 48					
Veterinary department			323 38	153 70	328.88	158.70	169.68					
Botany department			805.04	177.45	805.04	177.45	627.59					
Music			363 60		363.60		363 60					
Public rooms			1,976.90		1,976.90		1,976.90					
Contingent expense			5,260.29		5,260.29		5,260 29					
Library			1,636.82		1,636.82		1,636.82					
Domestic economy			272 82	64 18	272 82	64.18	208.64					
Political economy			22 00		22.00		22.00					
Mathematical department			1,068.64		1,068.64		1,068 64					

TREASURER'S REPORT—CONTINUED.

	BALANCES, NOVEMBER 11, 1897		FISCAL YEAR.		TOTALS.		INTEREST FUND.		MORRILL SUPPORT FUND.		BALANCES, JUNE 30, 1898.	
	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.
Military			166.73		166.73		166.73					
Mining engineering			10.55		10.55		10.55					
Agricultural chemistry			569.91	143.91	569.91	143 91	426 00					
Public grounds			1,266 86	46 26	1,266.86	46.26	1,220.60					
Sabbath services			266.25		266.25		266.25					
Pathology			34.54	1 25	34 54	1 25	33.29					
Station, experiment		21.81	8,833.32	8,824.36	8,833 32	8,846 17						12 85
State appropriations		16 01	20,046.99	20,039.86	20,046 99	20,055.87						8.88
Totals	$ 82,204 20	$ 99,062.43	$ 120,421.03	$ 115,260 14	$ 202,625.23	$ 214,822.57	$ 30,078.08	$ 37,806.08		$ 3,354 05		
Balance interest fund on hand							7,728.00		$ 3,354 05			7,728 00
Balance Morrill support fund on hand												3,834.05
Cash to balance											$ 65,054.20	$ 76,751.54
Experiment station	21 81			8 96	12 85						12.85	
State appropriations	16 01			7.13	8 88						8 88	
Morrill support fund	8,989 88			5,635.83	3,354.05						3,354.05	
Other sources	7,830.53		491.03		8,321.56						8,321 56	
Totals	$ 99,062.43	$ 99,062.43	$ 120,912 06	$ 120,912 06	$ 214,322.57	$ 214,322.57	$ 37,806 08	$ 37,806.08	$ 3,354.05	$ 3.354.05	$ 76.751.54	$ 76.751 54

TREASURER'S REPORT—STEWARD'S DIVISION.

	BALANCES, NOV. 11, 1897.		FISCAL YEAR.		TOTAL.		BALANCES, JUNE 30, 1898.	
	Debit.	Credit.	Debit.	Credit	Debit.	Credit.	Debit.	Credit
Boarding dept...	....	$ 557.52	$ 11,938.71	$ 11,886.76	$ 11,938.71	$ 11,944.28	....	$ 5.57
Damages..........	....	241.99	6 00	5.80	6.00	247 79	....	241.79
Hospital...........	....	299.85	686.19	485,33	686.19	735.18	....	48.99
Fire, lights and incidentals......	....	....	8,216.60	8,216 60	8,216 60	8,216 60	....	....
Piano rent........	....	1.50	39 00	48 50	39.00	50 00	....	11.00
F. J. Resler........	....	14 00	621.50	607.50	621.50	621 50	....	....
A. M. Newens.....	....	....	45.50	45 50	45.50	45.50	....	....
Cash to balance..	$ 1,114 86	....	....	307,51	307.35	....	$ 307.35	....
Totals.........	$ 1,114.86	$ 1,114 86	$ 21,553.50	$ 21,553 50	$ 21,860.85	$ 21,860 85	$ 307 35	$ 307.35

STATE APPROPRIATIONS.

The following is a statement of the different appropriations for the fiscal year ending June 30, 1898:

FUND.	Balance November 11, 1897.	Drawn from state treasurer.	EXPENDED.	BALANCES.	
				DR.	CR.
State contingent fund	....	$ 392.32	$ 393.82	.....	.....
State experimental fund	$ 8.40	13 30	21.70	.....	......
Improvements and current expenses	7.51	11,172.91	11,171.45	.....	$8.97
Waterworks	....	3,211.42	3,211.51	.09	.....
Forge shops	....	3,163.04	3,163.04	......	......
Remodeling farm barns	.10	3.22	3.32	....	......
Sewage disposal system	....	2,083.65	2,083.65	......	.....
Total	$16 01	$20.039.86	$20.046 99		$8.88

MORRILL FUND.

The following is a summary of the report made to the secretary of the interior for the fiscal year ending June 30, 1898:

Receipts.

July 1, 1897.	Balance on hand		$ 3,896.81
September 3.	Received from state treasurer		23,000.00
	Total		$26,896.81

Expenditures.

Paid for agricultural instruction	$ 8,220.53	
Paid for mechanic arts instruction	4,143.06	
Paid for English language instruction	716.64	
Paid for mathematical science instruction	1,155.53	
Paid for natural and physical science instruction	8,729.24	
Paid for economic science instruction	577.76	
Total		23,542.76
Balance cash on hand June 30, 1898		3,354.05
Total		$26,896.81

Respectfully submitted,

HERMAN KNAPP,
Treasurer.

TREASURER'S REPORT.

The following is a complete statement of the transactions of all the accounts for the fiscal year ending June 30, 1899.

	BALANCES JULY 1, 1898.		FISCAL YEAR.		TOTALS.		INTEREST FUND.		MORRILL SUPPORT.		BALANCES JUNE 30, 1899.	
	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.
Interest on lands belonging to congressional grant		$ 7,728.00		$ 3,217 47		$ 10,945.47		$ 10,945.47				
Interest on accumulated int.				5,838 31		5,838.31		5,838.31				
Interest on investment of endowment fund				37,869.14		37,869.14		37,869.14				
Interest on lands obtained by foreclosure				253.50		253.50		253.50				
Contingent principal fund		64,000.00	$ 19,850.00		$ 19,850 00	64,000 00						$ 44,150.00
Mortgages receivable	$ 64,000.00			19,850 00	64,000 00	19,850.00					$ 44,150.00	
Donation fund		28.83		32.00		60.83						60.83
Diploma fund		824.76	241.08	455 00	241.08	1,279 76						1.038.68
Room rent		706 17	2,013 76	2,778.81	2,013.76	3,484 98						1,471.22
Railroad damages		88 00				88.00						88.00
Personal accounts	476 95				476.95						476 95	
Bills receivable	577.25				577.25						577.25	
Morrill support fund		3.354.05	21,603 64	24,000.00	21,603 64	27,354 05			$ 21,603.64	$ 27,354.05		
Salaries			12.770.08		12,770 08		$ 12,770 08					
Farm department			10,049 90	6,973.34	10,049.90	6,973.84	2,476 56		600.00			
Creamery			20,833.92	19,033 94	20 833.92	19,033.94	1.799.98					
Dairy			2,617 17	974 88	2,617.17	974.88	342 83		1,299.96			
Horticulture			2,545.44	645.48	2,545.44	645.48	1,500.00	399.96				
Chemistry			1,992 65	952 60	1,992.65	952 60	90 05		950.00			
Civil engineering			1,619.96	20 00	1,619.96	20.00	800.00		799 96			
Entomology and zoology			754.19	213 31	754 19	213 31	540.88					
Mechanical department			7,202.69	3,121 44	7,202 69	3,121.44	4,081 25					
Physical department			2,400.60	300.05	2,400 60	300.05	2,100 55					
Veterinary department			1,011.79	240 80	1,011.79	240.80	770.99					
Botany			1,039.57	393.00	1,039.57	393.00	646 57					
Musical department			639 47		639.47		639.47					
Public rooms			432 05		432 05		432.05					
Contingent expense			6,719 82		6,719.82		6,719.82					
Library			2,692 14	.75	2,692.14	.75	2,691 39					
English			720.00		720.00		720 00					
Domestic economy			1,300 85	326.55	1,300.85	326.55	974.30					
Political economy			69.80		69.80		69 80					
Mathematical department			1,848.24		1,848.24		948 24		900,00			

TREASURER'S REPORT—CONTINUED.

	BALANCES JULY 1, 1898.		FISCAL YEAR.		TOTALS.		INTEREST FUND.		MORRILL SUPPORT.		BALANCES JUNE 30, 1899.	
	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.
Military			199.64		199 64		199.64					
Geology			193.85	3.35	193 35	3.35	190.00					
Mining engineering			102.29	2.50	102 29	2.50	99.79					
Agricultural chemistry			979.26	480.60	979 26	480.60	498.66					
Public grounds			1,358 26	31.89	1,358.26	31.89	1,326 37					
Sabbath services			422.03		422 03		422.03					
Pathology			98 58	6 50	98.58	6.50	92.08					
Experiment station		12.85	17,355 81	17,343.34	17,355.81	17,356 19						.38
State appropriations		8 88	30,211 57	30,202.69	30,211.57	30,211.57						
Totals	$ 65,054.20	$ 76,751.54	$ 173,889.60	$ 175,561 24	$ 238,943 80	$ 252,312.78	$ 43,942.88	$ 54,906.42	$ 26,553.52	$ 27,354 05		
Balance interest fund on hand							10,963.54					10,963.54
Balance Morrill support fund									800.53			800.53
Cash to balance.												
Experiment station	12.85			12.47	.38						.38	
Morrill support fund	3,354.05			2,553.52	800.53						800.53	
Other sources	8,321 56		4,206.51		12,568.07						12,568 07	
State appropriations	8.88			8.88								
Totals	$ 76,751.54	$ 76,751.54	$ 178,136.11	$ 178,136.11	$ 252,312.78	$ 252,312.78	$ 54,906.42	$ 54,906.42	$ 27,354.05	$ 27,354 05	$ 58,573.18	$ 58,573 18

TREASURER'S REPORT—STEWARD'S DIVISION.

	BALANCES JULY 1, 1898.		FISCAL YEAR.		TOTALS.		BALANCES JUNE 30, 1899.	
	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.	Debit.	Credit.
Boarding dept....	....	$ 5.57	$ 28,050.61	$ 28,580.67	$ 28,050.61	$ 28,586.24	....	$ 535.63
Damages	....	241.79	35.00	86.35	35.00	328.14	....	293.14
Hospital	....	48.99	903.85	1,011.30	903.85	1,060.29	....	156 44
Fires, lights and incidentals	....	....	14,363 95	14,362.95	14,362.95	14,362.95	....	....
Piano rent	....	11.00	37.30	67.50	37.30	78.50	....	41.20
F. J. Resler	....	....	572.85	572.85	572.85	572 85	....	....
A. M. Newens.....	....	....	79.75	155.30	79 75	155.30	.....	75.55
Cash to balance ..	$ 307.35	....	794.61	....	1,101.96	....	$1,101.96	....
Totals. ..	$ 307.35	$ 307.35	$ 44,836 92	$ 44,836.92	$ 45,144.27	$ 45,144.27	$ 1,101.96	$ 1,101.96

STATE APPROPRIATIONS.

The following is a statement of the appropriations for the fiscal year ending June 30, 1899:

FUND.	BALANCE JULY 1, 1898.		Drawn from state treasurer.	Expended.
	Debit.	Credit.		
State repair and improvement			$ 1,089.94	$ 1,089.94
State contingent fund			634 43	634.43
State experimental fund			25.90	25.90
Deep well			933.63	933,63
Water works fund	$ .09		109.93	109.84
Forge shops			5.55	5.55
Sewage disposal			1,371.80	1,371 80
Carpenter shop			5,000.00	5,000.00
Improvements and current expenses		$ 8.97	8,519.22	8,528.19
Improvements and current expenses			12,512.29	12,512.29
Total		$8 88	$ 30,202.69	$30,211.57

MORRILL FUND.

The following is a summary of the report made to the secretary of the interior for the fiscal year ending June 30, 1899:

Receipts.

July 1, 1898. Balance on hand		$ 3,354.05
July 21, 1898. Received from state treasurer		24,000.00
Total		$27,354.05

Expenditures.

For agricultural instruction	$ 7 920.58	
For mechanic arts instruction	7,149.80	
For English language instruction	1,566.64	
For mathematical science instruction	1,966.64	
For natural and physical science instruction	7,416.54	
For economic science instruction	533.32	$26,553.52
Balance cash on hand June 30		800.53
Total		$ 27,354.05

Respectfully submitted,

HERMAN KNAPP,
Treasurer.

REPORT OF COLLEGE ENGINEER ON SEWAGE DISPOSAL SYSTEM.

AMES, Iowa, November 29, 1899.

To the Board of Trustees of the Iowa State College, Ames, Iowa:

GENTLEMEN—I respectfully present the following report regarding the college sewage disposal plant, which was constructed in 1898, under the direction and according to the plans of myself as college engineer:

The appropriation for the construction of this plant was made by the legislature in 1896. Previous to the construction of the plant the outlet of the college sewage system was into an open ditch extending across the Squaw creek bottoms. This ditch was dry, except for the sewage, during part of the year, and constituted an open cesspool more than a quarter of a mile long. In order to abate this nuisance an appropriation of $3,500 was asked from the state and granted by the legislature, on the basis of an estimate of cost and detailed plans prepared by myself for a system of disposal by intermittent filtration through sand beds, substantially as since actually carried out, together with utilization of the sewage for fertilization of growing crops by irrigation during part of the year.

Before proceeding with the construction of the system the board of trustees, recognizing that no such plant had ever before been constructed in this state, made a long and careful investigation as to the feasibility of carrying out the plans. The result was a delay of two years, so that construction was not proceeded with until 1898. They also decided to omit the irrigation feature of the plans, which was not essential to a complete system, and, as the law permitted, use the money so saved for extending the college sewage system.

Short lines of sewers were thus constructed late in 1897, competitive bids being secured from local parties. Bids for the remaining sewers and for the sewage disposal system proper were advertised to be opened April 29, 1898. On that date the following bids were received:

BIDDER.	SEWAGE DISPOSAL	SEWERS.	TOTAL.
J. L. Black, Boone, Iowa	$2,390.00	$856.75	$3,246.75
J. Hurley & Co, Des Moines	3,437.00	950.55	4,387 55
Orellin & Lovell, Des Moines	3,720.00	828.53	4,548.53
W. L. Thomas, Ames, Iowa	3,175 00	777.65	3,952.65
Jackson & Moss, Des Moines	2,825.00	745.70	3,570.70

The contract was awarded to the lowest bidder, Mr. J. L. Black, of Boone, Iowa. He began work May 9, 1898, and finished August 4, 1898. In addition to his contract price for the sewage disposal plant he was paid $31.45 for various extras, making a total for the disposal plant proper of $2,421.45. His final estimate on the sewers was $840.60, of which $1.65 was for extras. The reduction from the contract price was due to the omission of one short sewer and to some slight changes in the lengths of others, so that only 2,615 lineal feet were actually constructed as compared with 2,670 feet, included in the bid.

The total expenditures from the sewage disposal appropriation were as follows:

J. L. Black's contract for sewage disposal plant	$2,421.45
J. L. Black's contract for 2,615 feet of sewers	840.60
Seven hundred and fifteen lineal feet of sewers constructed in 1897	142.14
*Surveying, draughting and inspection	43.30
Printing specifications and advertising	47.55
Express, freight, telephone, postage, type-writing	4.96
Total	$3,500.00

*NOTE—In addition to the above some surveying and inspection was paid for from the repair fund.

The original bills for all of the above are on file with the college treasurer.

All of the work was very carefully inspected during its progress. In this work and in the draughting on the plans I was assisted by Miss Elmina Wilson, instructor, and by Messrs. J. H. Mykoff, M. J. Hammer, S. W. Tarr and A. J. Perrin, students in the civil engineering department. I desire to commend their faithful services. I also desire to acknowledge valuable advice received from Messrs. H. W. Clark and H. F. Mills, gentlemen connected with the Massachusetts State Board of Health. Their advice in connection with the preparation of the plans was freely given as a matter of courtesy from the state of Massachusetts to the state of Iowa.

The work was executed under the direction of the building committee of the board of trustees.

The sewage disposal plant which was planned and constructed in the manner described above is shown on the accompanying general plan. It is located about 1,000 feet east of the college creamery, which is the nearest inhabited building.

The plant consists first of a receiving tank, about 22x56x4 feet, having a concrete bottom, brick walls, and a wood cover coated with tar and gravel. At the end of the tank where the sewage enters, an area about 8x20 feet is partitioned off for a settling chamber, to retain most of the solids in the sewage. By division walls the sewage is compelled to flow slowly back and forth across the chamber for a distance of sixty feet, after which it passes through a screen into the other part of the tank, which is called the flushing chamber. The flushing chamber has a capacity of about 20,000 gallons, and whenever the sewage in it rises to a high-water line the entire contents are rapidly discharged automatically, by means of a siphon, upon the filter beds. By this means an intermittent application of the sewage to the beds is secured.

Each of the two filter beds shown on the plans contains an area of about two-tenths of an acre, and is made of sand and gravel, averaging four feet in depth. The sewage from the receiving tank is brought in sewer pipes, extending along two sides of each bed, and flows out upon the surface. After the sewage has percolated through the sand and gravel the purified effluent is removed by three tile drains under each bed, extending lengthwise of the beds and discharging into the channel of a small creek. The sewage as it flows upon the beds is foul-smelling and appearing, but the effluent coming from the tile drains is as limpid, clear and odorless as the purest spring water. This high degree of purification is effected by countless billions of bacteria which live in the pores of the sand and eat up the impurities in the sewage. At intervals of a few weeks a little scum has to be removed from the surface of the beds, but otherwise there is practically no accumulation of filth in or upon them, and with proper attention they will last indefinitely. This system is known as intermittent filtration, and intermittent application of the sewage is necessary to the life of the purifying organisms.

The completed beds and the receiving tank are surrounded by neat painted fences. A waste sewer with a by-pass, together with valves on all pipes, allows exact control of the disposition of the sewage under all conditions likely to occur. The average flow of sewage is about 40,000 gallons daily while college is in session, so that the filter beds are worked at the rate of about 100,000 gallons per acre per day.

About once a month the settling chamber has to be cleaned. This is easily done by merely opening a valve and allowing the semi-liquid contents to flow out upon the surface of a small covered sand filter, called the sludge bed, located upon lower ground near by. Here the sludge is allowed to stand and drain until it becomes dry enough to handle with a shovel, after which it is loaded on wagons and hauled away to be spread for fertilizer upon the farm. Usually six to eight loads are obtained at each cleaning.

The sewage disposal plant has now been in operation since August, 1898, and has been an unqualified success in every particular. The plant is not especially offensive, and such odors as exist cannot be noticed at any great distance. I have kept a vial containing a sample of the affluent (taken at random) for months at a time on my desk, side by side with another vial containing perfectly pure water from our deep well. People who were asked to examine them could not tell either from appearance or from odor which was which. Our weekly chemical analyses show 90 per cent to 95 per cent of purification, while the bacterial analyses show that 99.9 per cent of the bacteria are removed. We would not pronounce the affluent a safe drinking water, but we have no doubt that a great deal of less pure water is actually drank.

This sewage disposal plant, the first in Iowa, is not only abating a nuisance at the college but also is serving as an object lesson to the cities of the state. More and more as the population of our state increases is the question of sewage disposal becoming of vital importance to our towns. One Iowa city this year advertised for bids for the construction of a plant, and I am informed that its authorities employed an eastern engineer and made an expensive trip to New England to inspect disposal systems. More sensibly the authorities of another place, one cf our principal cities, came here to examine a plant in actual operation under Iowa conditions.

Realizing the great value to Iowa citizens of properly kept records of the college plant and of investigations conducted in connection with it, my colleagues, Professors J. B. Weems and L. H. Pammel, have joined with me in obtaining the data for complete records and in conducting investigations. The board of trustees has given authority for this and has provided the necessary funds. We are making regular weekly chemical and bacterial analyses of the sewage and affluent, and are keeping many other records in connection with the plant. We are studying the degree of purification secured, the effect of Iowa climatic conditions upon the operation of such a plant, the amount of sewage which can be cared for, and the effect of the receiving tank in increasing this amount by effecting a partial preliminary purification. The investigations will be extended to other subjects when practicable and the results will be published in such a way as to make them accessible to all persons wishing to know them.

Respectfully submitted,

A MARSTON,
College Engineer.

REPORT OF THE SECRETARY.

INCLUDING A SUMMARY OF PROCEEDINGS OF THE BOARD OF TRUSTEES.

MEMBERS OF BOARD OF TRUSTEES.

Leslie M. Shaw, ex-officio, Governor of the State.
R. C. Barrett, ex-officio, Superintendent of Public Instruction.

	TERM EXPIRES.
First district—Hon. S. H. Watkins, Libertyville	1904
Second district—Hon. C. L. Barclay, West Liberty	1904
Third district—Hon. J. S. Jones, Manchester	1902
Fourth district—Hon. A. Schermerhorn, Charles City	1904
Fifth district—Hon. A. V. Stout, Parkersburg	1900
Sixth district—Hon. W. O. McElroy, Newton	1902
Seventh district—Hon. C. F. Saylor, Des Moines	1900
Eighth district—Hon. W. B. Penick, Tingley	1904
Ninth district—Hon. L. B. Robinson, Oakland	1902
Tenth district—Hon. J. B. Hungerford, Carroll	1900
Eleventh district—Hon. W. J. Dixon, Sac City	1900

OFFICERS OF THE BOARD.

Hon. W. O. McElroy, Newton	Chairman
Edgar W. Stanton, Ames	Secretary
Herman Knapp, Ames	Treasurer
John Franklin Cavell, Ames	Steward

STANDING COMMITTEES OF THE BOARD.

GROUP 1.

Finance Committee—Governor Shaw and Trustees Robinson, Barclay, Penick, Barrett, Saylor and McElroy.

Building Committee—Trustees Hungerford, Jones, Dixon, Stout and Watkins, the first three named to constitute the statutory committee.

GROUP 2.

Committee on Agriculture, Horticulture, Experiment Station and Veterinary Science—Trustees Stout, Schermerhorn, Barclay, Governor Shaw, Dixon and Saylor.

Committee on Steward's Department, College Hospital and Sanitary Arrangements—Trustees Watkins, Hungerford, Robinson and Barrett.

Committee on Engineering Departments and Physics—Trustees Jones, Penick, and McElroy.

GROUP 3.

Committee on Faculty and Courses of Study—Trustees Barrett, Robinson, Hungerford, McElroy, Stout and Schermerhorn.

Committee on College Lands and Investments—Trustees Penick, Jones, Governor Shaw and Barclay.

Committee on Rules—Trustees Saylor, Watkins and Dixon.

GROUP 4.

Committee on Scientific Departments—Trustees Schermerhorn, Stout, Hungerford and Governor Shaw.

Committee on Literary Departments and Library—Trustees Robinson, Saylor, Barrett and Watkins.

Committee on Public Grounds and Assignment of Rooms—Trustees Barclay, Jones and McElroy.

Committee on Bonds—Trustees Dixon and Penick.

PERIOD COVERED BY THIS REPORT.

The last general assembly changed the fiscal year of the college, which had previously ended on the second Wednesday following the first Monday in November, so as to make it end on June 30th. This report, therefore, does not extend over two full years, but includes only the period from November 11, 1897, to July 1, 1899.

MEMBERSHIP OF THE BOARD.

The board of trustees consists of the governor of the state and the superintendent of public instruction, who are members by virtue of their office, and one trustee from each congressional district. The term of office is six years, beginning with the first of May following election by the general assembly. The terms of the following trustees expired on May 1, 1898: Hon. Hamilton Smith, First district; Hon. C. M. Dunbar, Second district; Hon. A. Schermerhorn, Fourth district and Hon. A. B. Shaw, Eighth district. Hon. S. H. Watkins was chosen to succeed Mr. Smith, Hon. C. L. Barclay to succeed Mr. Dunbar and Hon. W. B. Penick to succeed Mr. Shaw. Mr. Schermerhorn was re-elected, but owing to illness has been unable to perform the duties of trustee. In addition to filling this vacancy, members to represent the Fifth, Seventh, Tenth and Eleventh districts are to be elected by the Twenty-eighth General Assembly.

THE COLLEGE PLANT.

It is one of the duties of the board of trustees "to control and manage the property of the college and farm, whether real or personal." Aside from the college endowment this property consists of a farm of about 840 acres, forty-three farm and college buildings and the equipment of the several departments of the institution. The following is an estimate of the value of this property which may be said to constitute the college plant:

Land—		
Farm proper, 581.38 acres at $60	$ 34,882.80	
Experiment station grounds, 60 acres at $100	6,000.00	
Plots for horticultural experiments, 13 acres at $65	845.00	
Orchard and arboretum, 25 acres at $75	1,875.00	
College campus, 125 acres at $100	12,500.00	
College park, 37 acres at $45	1,665.00	
Total for 841.38 acres		$ 57,767.80
Buildings—		
Main college building	$ 150,000.00	
Boarding cottages	10,000.00	
Margaret hall	60,000.00	
Morrill hall	40,000.00	
Chemical and physical building	25,000.00	
Music hall	5,000.00	
Chime and clock tower	7,000.00	
College hospital	3,500.00	
Office building	7,000.00	
Book department building	1,800.00	
Engineer hall	15,000.00	
Carpenter shop	5,000.00	
Forge shop	5,000.00	
Power station	4,500.00	
Old pumping station plant	1,450.00	
Fire department building	175.00	
Foundry store house	100.00	
Greenhouse	5,000.00	
Veterinary hospital	8,000.00	
Agricultural hall	45,000.00	
Creamery, { Creamery proper, $10,000.00 Dormitory portion, $5,000.00 }	15,000.00	
Ice house	600.00	
Cattle barn	7,000.00	
Feeding shed	600.00	
Experiment station barn	4,000.00	
Horse barn	500.00	
Hog house	1,500.00	
Movable hog houses, fifteen	150.00	
Sheep barn	1,000.00	
Servant's hall	3,000.00	
Residences occupied by—		
Professor Curtiss	5,000.00	
Professor Weems	2,500 00	
Professor McKay	1,500 00	
Professor Bissell	2,500.00	
Professor Summers	2,500.00	
Professor Noble	3,000 00	
Professor Stanton	4,000 00	
Professor Marston	3,000 00	
Boarding club	1,000.00	
Farm foreman	1,100.00	
Horticultural foreman	1,200.00	
Experiment station foreman	1,000.00	
Farm laborer	800.00	
Total		$ 460,975.00

General equipment—			
Waterworks including water tower, deep well, pumping machinery and piping system		$ 37,000.00	
Power plant including three boilers, three high speed engines, piping, boiler and engine room appliances, etc		6,500.00	
Electric light including four dynamos, switch board appliances, pole line and transformers		5,500 00	
Sewerage system		3,500.00	
Sewage disposal system		2,500.00	
Office building furniture		2 000.00	
Furniture of public rooms		5,300.00	
College hospital furniture		3,500.00	
Boarding department		2,200.00	
Fire department		1,525.00	
Total			$ 69,525.00
Department equipment—			
Experiment station:			
Agricultural section	$ 3,400.00		
Horticultural section	125 00		
Chemical section	2,861.90		
Botanical section	1,826.50		
Dairy section	100.00		
Entomological section	1,055.35		
Veterinary section	468.00		
Library	500 00		
Total		$ 10,336 75	
Farm		18,919.92	
Creamery		3,442.87	
Horticultural department		1,850.00	
Veterinary department		2,310.72	
Pathology and histology		356.75	
Agricultural chemistry		1,624 00	
General chemistry		8,340.63	
Zoology (including gas machine)		14,461.00	
Botany		15,500.00	
Geology		2,912.00	
Physics and electrical engineering		14,718.98	
Civil engineering		5,344.20	
Mechanical engineering		28,005.91	
Mining engineering		855.00	
Domestic economy		1,532.87	
Military department		450 00	
English literature and rhetoric		175.00	
Potitical economy		100.00	
Public grounds		122.50	
Library		23,200.00	
Muscial department		1,000.00	
Pipe organ		2.500.00	
Chimes and clock		9,000.00	
Total			167,059.10
Total value of college plant			$755,326.90

This amount would divide along the line of the purposes to which it is devoted, about as follows:

General, including dormitories, public grounds, offices, general library, waterworks plant, etc	$397,948.00
Agriculture	244,354.81
Mechanic arts	113,024.09
Total	$755,326.90

It is provided in the national law that a portion of the endowment fund may be used to purchase land for college farm purposes whenever authorized by the legislature. Under the authority granted by the last general assembly the board of trustees purchased forty acres known as the Kintzley tract, joining the land already owned by the college on the north and east, paying therefor $2,000. The board had previously sold a tract of 85 acres, which was disadvantageously situated on the north side of Squaw creek, crediting the proceeds, $3,625, to the endowment fund. The farm, with these changes, consists, as already stated, of 841.88 acres, described as follows:

W. fr. ½ of Sec. 3, E. fr. ½ of Sec. 4, E. fr. ½ of W. ½ of Sec. 4. Ten acres off from the east side of the W. ½ of the N. W. ¼ of Sec. 4, Twp. 83, Range 24, containing 657.88 acres.

Also the S. E. ¼ of the S. E. ¼ of Sec. 33, and the W. ½ of the S. E. ¼ of Sec. 33, and the East 3-8 of the S. W. ¼ of Sec. 33, and 2½ acres south of Chicago & N. W. R. R. track in the S. W. ¼ of Sec. 33, all in Twp. 84, Range 24, containing 182.51 acres. Lot 2, N. E. of N. E. 9–83–24, containing one acre.

The funds derived from national sources cannot be applied directly or indirectly under any pretense whatever to the purchase, erection, preservation or repairs of any building or buildings. Outside of the purchase of farm land the enlargement and maintenance of the college plant is made to rest entirely upon the state.

THE COLLEGE ENDOWMENT FUND.

A second important duty of the board of trustees is the management of the college endowment fund. This fund had its origin in the grant of lands made in 1862 by the national government to the several states and territories for the purpose of providing colleges for the benefit of agriculture and mechanic arts. Under this grant Iowa received about 204,000 acres of land. This land was rented on ten-year leases at an annual rental of 8 per cent on a valuation fixed in advance by the board of trustees. The lessee was granted the privilege of purchase at this valuation upon the expiration of his lease or a renewal of such lease on the same valuation for a new term of five or ten years. When leases were forfeited for non-payment of rental the land was re-appraised and again rented. By the increase in appraisement and the transfer, in the earlier years, of the unused income, the endowment fund was gradually augmented until at the beginning of the period covered by this report it amounted to $681,033.52. During this period there has been added to this fund:

The proceeds of the sale of North farm	$ 3,625.00
Part payment on sale of donated land situated near Ontario	150.00
Proceeds of sale of old buildings on Kintzley tract	25.00
Total	$ 3,800.00
Less amount paid under the authority of the general assembly for the purchase of the Kintzley tract of 40 acres	2,000.00
Net addition to the fund	$ 1,800.00

Thus bringing the total endowment to $682,833.52, credited in its origin as follows:

To the original congressional land grant	$ 589,379.01
To transfers and investments of interest fund	93,304.51
To sale of donated land	150.00
Total	$ 682,833.52

The fund is invested in land and farm mortgages, and with the exception of two tracts of land leased directly by the board of trustees, is managed through (*a*) the land and loan agency, under the charge of Herman Knapp, and (*b*) the financial agency, under the charge of W. A. Helsell. The fund in amount is divided along these several lines as follows:

1. Under direct control of the board, land valued at	$ 3,618.55
2. Land and loan agency, Herman Knapp, agent	81,125.45
3. Financial agency, W. A. Helsell, agent	598,089.52
Total	$ 682,833.52

I. FUND UNDER DIRECT CONTROL OF THE BOARD.

The land composing this portion of the endowment fund includes the following tracts, obtained under foreclosure of mortgage:

120 acres in Ringgold county, cost...	$	1,200
40 acres in Polk county, cost.......		2,418.55
Total......................	$	3,618.55

The Ringgold tract is rented at an annual rental of $126; the Polk county tract on short time at $85.

II. LAND AND LOAN AGENCY.

In the last biennial report, the land charged to the agency is stated at 11,989.17 acres. In an accounting with the agent at a later date the following corrections were found necessary:

Add N. W. 1-4 30, 97, 28, a tract in conflict with swamp land entry, which, through mistake, had been deducted twice, acres	149.67	
Add amount of error in original list, acres	.10	
Total..........................	149.77	
Deduct error in amount of land sold during biennial period of 1896–97, acres	60.00	
Net additional, acres..............		89.77

These changes affect the acreage only, and not the value of the land as a whole, which is correctly given in the last biennial report. At the beginning of the present period then the land chargeable to the agency amounted to 12,078.94 acres, appraised at $52,791.45.

During the year there has been patented:

Of the congressional grant, 3,840 acres, appraised at................	$	15,016.00
Of land purchased with accumulated interest fund, 160 acres, appraised at		800.00
Total, 4,000 acres, appraised at....	$	15,816.00
Leaving as the amount now charged to the agency 8,078.94 acres, appraised at		36,975.45

All of this land is under lease at an annual rental, payable in advance, of 8 per cent on its appraised value.

At the beginning of the period covered by this report there was in the hands of Agent Knapp an uninvested balance of accumulated interest of............................	$ 2,530.00
During the period loans have been paid amounting to.................	27,000.00
Land purchased with accumulated interst, sold, amounts to..........	800 00
North farm sold and proceeds credited to accumulated interest fund..	3,625.00
Total............................	$ 33,955.00

This amount has been forwarded to the state treasurer and placed to the credit of the financial agency. The uncollected principal on loans made by Agent Knapp amounts to $44,150.

III. THE FINANCIAL AGENCY.

At the beginning of the fiscal period there was an unexpended balance to the credit of this agency of........		$ 29,119.89
Mortgage loans paid during the period amounted to..............		158,185.06
Principal of leases paid during the period............................		15,016.00
Transferred from land and loan agency..		33,955.00
Proceeds of sale of donated land....		150.00
Old building on Kintzley tract sold...		25.00
Making a total to be invested of..		$ 236,450.95
The agent has loaned during the period....	$146,200.00	
The board under authority of the legislature purchased the Kintzley tract for.........	$ 2,000.00	
Total..............		$ 148,200.00
Leaving an uninvested balance of		$ 98,250.95

In hands of the financial agent	$ 5,728.99	
In the hands of the state treasurer	92,521.96	
Total		$ 98,250.95

Extensions have been granted during the period as follows:

Bearing 7 per cent interest	$ 6,300.00
Bearing 6 per cent interest	3,200.00
Total	$ 9,500.00

The financial agency was established in 1884. It has loaned $1,035,625.80.

Only three foreclosures have been made and these resulted in a gain to the college. The present agent, W. A. Helsell, has had charge of the agency since June 15, 1891. To meet the provisions of the code of 1897 a new contract with Mr. Helsell was made in July, 1898, of which the following is a copy:

CONTRACT WITH FINANCIAL AGENT HELSELL.

This contract by and between the board of trustees of the Iowa State College of Agriculture and Mechanic Arts and W. A. Helsell, witnesseth: That the said Helsell, having been appointed financial agent of said college by the trustees thereof, by virtue of chapter IV, title XIII of the code, he (the said Helsell) agrees to conduct said agency according to the terms of said code and this agreement.

1. All loans negotiated shall be upon the following terms: The rate of interest shall be such as is or shall be designated by the board of trustees, payable annually, principal and interest payable to the order of said board of trustees at the office of the state treasurer at Des Moines, Iowa. The principal to be due in not less than five nor more than ten years and the borrower to have the privilege, after such time as shall be fixed by the board, to make payments of principal in sums of $100 or multiples thereof, at such times as interest matures.

2. The said financial agent shall only use such forms of notes, bonds and mortgages, coupons and other papers, and shall observe such instructions as may be prepared by the attorney-general under the direction of the executive council for the purpose of and pursuant to the fourth paragraph of section 2667 of the code.

3. He, the said agent, shall not loan less than $500 nor more than $10,000 to any one person.

4. He, the said agent, shall draw from the state treasury the said endowment fund, from time to time, as provided by section 2665 of the code to enable him to make such loans, provided that he at no one time shall have in his possession nor under his control, more than $10,000. In determining this amount, the secretary may credit the financial agent with the amount of any loan when the application therefor, its accompanying examiner's report, coupon note and mortgage duly recorded, or, in lieu of the mortgage the certificate of the county recorder or the abstractor of title, showing that the mortgage has been duly filed for record, are filed with him; but, in such case, the responsibility of the financial agent for the loan shall continue and he shall be charged again with each such loan not fully completed within forty days thereafter. He shall exercise care and diligence in making such loans and in selecting or retaining any one to assist him in preparing abstracts of title and in the doing of any act in any way connected with said loans, and if any sum of money is lost or expense incurred, through his wilful or negligent acts or the wilful or negligent acts of his sub-agents, the said Helsell shall be fully liable to the said board of trustees therefor.

5. And the said agent shall also be liable for any want of diligence in making said loans; and for all moneys lying and being in his hands for an unreasonable time, or for any time during which, by diligence or proper effort, the same might or could have been loaned, the said agent shall be liable for interest thereon at the rate of 7 per cent per annum.

6. He shall report to the secretary of the said board of trustees annually, or as often as may be required by the said board, his doings since his last report. He shall keep a complete abstract of each of said loans and a full and complete record and register of all his doings, and keep all letters received and press or typewritten copies of all letters sent, all of which records and correspondence shall be turned over to his successor in office, or said board, and at all times shall be open to the inspection of any member of the executive council, the attorney-general, or any member of the board of trustees of said college, or their duly appointed agent. The agent shall forward to the secretary of the board all papers relating to such loans.

7. He shall receive a salary of $1,200 per annum, payable monthly, and all necessary expenses connected with the discharge of his duties, and, also, not to exceed the sum of $800 per annum in addition for assistants and sub-agents. The $1,200 to be paid out of the state treasury in equal monthly installments as provided by law, and the expenses and money for assistants and sub-agents to be drawn as required, by itemized statements duly verified by the financial agent, and approved by the chairman and secretary of the board of trustees.

8. Each loan shall be secured by a mortgage paramount to all other liens upon improved farms in the state of Iowa, and shall not exceed 50 per cent of the cash value of the mortgaged premises, exclusive of buildings.

9. This contract fully recognizes the regulation of the board that the time of foreclosure of mortgages of delinquent loans shall be decided by a committee consisting of the chairman and secretary of the board of trustees and the financial agent, and the said financial agent hereby agrees that said provision for ordering foreclosures shall not in any way lessen his responsibility, but no delay in ordering foreclosures shall exceed six months.

10. The said Helsell shall take charge of the foreclosure of mortgages and collection of bonds from delinquent debtors to the endowment fund, as provided by law, and shall promptly remit all amounts thus collected to the treasurer of state as directed by law; but the agent shall, before commencing foreclosure proceedings, give twenty days' notice by letter deposited in the postoffice, directed to the mortgagor at his known place of residence.

11. The said Helsell shall at all times be subject to the rules, orders and directions of the said board of trustees.

12. The said Helsell shall hold his office as financial agent during the pleasure of the board of trustees.

In witness thereof, this contract is executed in duplicate by the Iowa State College of Agriculture and Mechanic Arts, by the chairman and secretary of the board of trustees, duly authorized so to act, and by the said W. A. Helsell, in his own proper person, this 20th day of July, 1898.

W. A. HELSELL.

The board of trustees of the Iowa State College of Agriculture and Mechanic Arts. By W. O. MCELROY,
Chairman.
E. W. STANTON,
Secretary.

The bond of the agent was fixed at $30,000. Trustee Dixon, who was appointed a committee to investigate the financial responsibility of the bondsmen, reported that they were large land owners in Sac county, and that he considered the bond ample to protect the interests of the college. The bond was approved by the board of trustees and afterwards by the state executive council.

Under the law all payments for land are forwarded to the state treasurer and credited to the financial agency. The 8,000 acres remaining under lease will be patented in the near future and the entire land system closed out. The accumulated interest portion of the endowment which has hitherto been managed in connection with the land department has been ordered by the board transferred to the financial agency. This is being done as rapidly as loans are paid in. The endowment fund as a whole will thus in a few years come to be managed through the financial agency. It is therefore a matter of special congratulation that this method of handling the fund has proven a safe and efficient one. An experience of fifteen years has shown that it is well suited to conserve the safety and promote the productiveness of the fund. One special advantage of the system is that the board of trustees can at any time obtain, in the office of their secretary, full information regarding the condition of the fund. When money is drawn by the agent from the state treasury for investment, the orders are countersigned by the secretary of the board of trustees. The papers connected with each loan are sent by the agent to the secretary, who enters them of record and then forwards them to the state treasurer, who collects principal and interest when due. Monthly reports are rendered to the secretary, whose books are thus made to show at the close of each month the condition of each loan and of the fund as a whole. The accounts of the secretary are compared with those of the officers handling the fund and the correctness of their books thus tested.

With no losses in its history, and an aggregate income second only to that received by New York from the national grant, the management of this fund may be considered as an example of wise and conservative public financering.

PRESENT CONDITION OF THE ENDOWMENT FUND.

The books of the secretary show that on June 30th, last, the condition of the fund was as follows:

INVESTED.	
Land under lease at 8 per cent (including Ringgold tract), 8,198.91 acres, appraised at	$ 38,175.45
Farm mortgages at 7 per cent	402,088.57
Farm mortgages at 6 per cent	141,900.00
Polk county tract at $85 per annum	2,418.55
Total yielding income	$584,582.57
UNINVESTED.	
Cash balance	$ 98,250.95
Total endowment	$682,833.52

It will be noticed that nearly $100,000 of the endowment fund is invested. Many additional loans are payable on October 1st and January 1st. By the first named date the uninvested balance will be increased to $150,000, and by January 1, 1900, will probably exceed $200,000. This most serious condition of affairs is due to the fact that the law will not permit the fund to be loaned at less than 6 per cent, while it is only now and then that a 6 per cent loan can be obtained. The matter should receive the early attention of the legislature. The following draft of a bill was approved by the board of trustees, and is submitted to the general assembly for consideration:

A BILL

For an act to amend section twenty-six hundred and sixty-seven of the code, relating to the rate of interest to be charged in the lending of money of the endowment fund of the State College of Agriculture and Mechanic Arts.

Be it enacted by the General Assembly of the State of Iowa:

SECTION 1. That section twenty-six hundred and sixty-seven of the code be, and the same is hereby amended, by striking out of the fourth and fifth lines of said section, as found in subdivision one thereof, the words "not less than 6 per cent per annum, payable annually."

SEC 2. This act, being deemed of immediate importance, shall take effect and be in force on and after its publication in the Iowa State *Register* and the Des Moines *Leader*, newspapers published in Des Moines, Iowa.

INCOME AND EXPENDITURES.

The following statement shows the sources from which the funds for maintaining and developing the college are derived. They also give in condensed form the income and expenditures for the time included in this report:

(A) FOR THE PERIOD EXTENDING FROM NOVEMBER 11, 1897, TO JULY 1, 1899.

		Receipts.	Expenditures.
1.	National support funds	$ 39,609 62	$ 42,499.27
2.	National experiment station fund	7,500.00	7,521.81
3.	Miscellaneous items: rent of rooms, diploma fees and rental on donated land	1,260 85	986 00
4.	Annual state appropriation	11,578 53	11,585.47
5.	Special appropriations by the state for buildings and improvements	8,461.33	8,461.52
	Totals	$ 68,410.33	$ 71,054.07

The excess of expenditures over income, amounting to $2,643.74, is represented by a corresponding decrease in the cash balance which was in the hands of the treasurer at the beginning of the period. It should be noted that owing to the change in the college fiscal year the foregoing statement covers only seven and two-thirds months.

(B) FOR THE FISCAL YEAR ENDING JUNE 30, 1899.

		Receipts.	Expenditures.
1.	National support funds	$ 71,178.42	$ 70,496.40
2.	National experiment station fund	15,000.00	15,000.00
3.	Miscellaneous items: rent of rooms, diploma fees and rental on donated lands	3,265.81	2,254.84
4.	Annual state appropriation	22,781.78	22,790.75
5.	Special appropriations by the state for buildings and improvements	7,420.91	7,420.82
	Totals	$ 119,646.92	$ 117,962.81

Since the income exceeded the expenditures by $1,684.11, the treasurer's cash balance was increased by that amount.

The income for the year was increased by the payment, owing to prosperous business conditions, of considerable delinquent interest, and by the drawing of an old balance to the credit of the annual state appropriation. With these items stricken out the income inclusive of new buildings would have been about $105,000.

Proceeding now to consider the income and expenditures in detail under the headings used in the condensed statement, we find:

I. NATIONAL SUPPORT FUNDS.

The following shows the ordinary income of the college from the national support funds for the partial fiscal year ending June 30, 1898, together with the expenditures on account of the various departments:

INCOME 1897-8.

Rental on endowment fund land	$ 2,374.83	
Rental on land purchased with interest fund	108.75	
Interest on endowment fund invested in farm mortgages	23,027.81	
Rental on land obtained by the foreclosure of endowment fund mortgages	168.50	
Interest on interest fund invested in farm mortgages	5,929.73	
		$ 31,609.62
Morrill support fund—part of installment for 1897-8		8,000.00
Total net income from national support funds		$ 39,609.62

EXPENDITURES.

Salaries—		
Morrill fund	$ 13,635.83	
Interest fund	8,397.94	
Total		$ 22,033.77
Agricultural department—		
Current expenses	$ 1,393.85	
Foreman	400.00	
Class expenses	91.91	
Total		1,885.76
Creamery cr. $248 78		
Dairy—		
Salary of G. L. McKay	$ 800 00	
Salary of assistant	66.64	
Total		866 64
Apparatus and current expenses cr. $85.59		
Horticultural department—		
Current expenses and experimentation cr. $1,220.98		
Assistant		255.12

Veterinary department—		
House surgeon	$ 75.00	
Current expenses and apparatus	94.68	
Total		169.68
Pathological department—		
Current expenses and apparatus		33.29
Mechanical department—		
Assistants	$ 1,545.26	
Current expenses and equipment	1,219.38	
Total		2,764.64
Civil engineering—		
Assistants	$ 150.00	
Current expenses and equipment	403.78	
Total		553.78
Physics and electrical engineering—		
Current expenses and apparatus	$ 266.48	
Assistants	350.00	
Total		616.48
Mining engineering		10.55
Military tactics and physical culture—		
Currrent expenses and flags		166.73
Department of chemistry—		
Assistants	$ 475.00	
Current expenses and apparatus	526.71	
Total		1,001.71
Agricultural chemistry—		
Assistant, current expenses and apparatus		426.00
Entomology and zoology—		
Current expenses and apparatus		619.14
Botany—		
Assistants	$ 174.99	
Current expenses and apparatus	452.60	
Total		627 59
Mathematics and secretary's office—		
Assistants and clerk hire		1.068.64
Political economy		22.00
Domestic economy		208.64

Department of music—		
Salary of director	$ 250.00	
Instrumental music, public exercises	50.00	
Current expenses	13.60	
Music for Sabbath services	50.00	
Total		363 60
Library—		
Librarian	$ 370.83	
Assistant	175.00	
Expenses, books and periodicals	1,090.99	
Total		1,636.82
Public grounds		1,220.60
Sabbath services		266.25
Public rooms—		
Furniture	$ 15.52	
Heating, lighting and janitor service	1,961.38	1,976.90
Contingent expenses		5,260.29
Total		$ 44,054.62
Less dairy credit	85.59	
Creamery credit	248.78	
Horticultural credit	1,220.98	1,555.35
Total net ordinary expenses		$ 42,499.27

The following shows the ordinary income of the college from the national support funds for the fiscal years ending June 30, 1899, together with the expenditures on account of the various departments:

INCOME 1898-9.

Rental on endowment fund	$ 3,217.47	
Rental on land purchased with interest fund	415.95	
Interest on endowment fund invested in farm mortgages	37,869.14	
Rental on land obtained by the foreclosure of endowment fund mortgages	253.50	
Interest on interest fund invested in farm mortgages	5,422.36	
		$ 47,178.42
Morrill support fund		24,00.00
Total		$71,178.42

EXPENDITURES.

Salaries—		
Morrill fund	$ 21,603.64	
Interest fund	12,770.08	
		34,373.72

Agricultural department—		
Current expenses and purchase of cattle	$ 2,047 32	
Foreman	600.00	
Class expenses	354.24	
Omaha exhibit	75 00	3,076.56
Creamery		1,799.98
Dairy—		
Salary of G. L. McKay	$ 1,299.96	
Salary of assistant	260.91	
Apparatus and current expenses	81.42	1,642.29
Horticultural department—		
Assistant	$ 399.96	
Current expenses and apparatus	1,500.00	1,899.96
Veterinary department—		
House surgeon	$ 225.00	
Assistant	200 00	
Current expenses and apparatus	345.99	770.99
Pathological department		92.08
Mechanical department—		
Assistants	$ 3,086.25	
Current expenses and equipment	995.00	4,081.25
Civil engineering—		
Assistant	$ 799.96	
Current expenses and equipment	800.00	1,99.596
Physics and electrical engineering—		
Assistants	$ 800 00	
Current expenses and apparatus	1,300.55	2,100.55
Mining engineering		99.79
Military department—		
Current expenses and flags		199.64
Department of chemistry—		
Assistants	$ 950 00	
Current expenses and apparatus	90.05	1,040.05
Agricultural chemistry—		
Assistant, current expenses and apparatus		498.66

Department of zoology—		
Assistants	$ 191.40	
Current expenses and apparatus	349.48	
		540.88
Geology		190.00
Botany—		
Assistants	$ 350.00	
Current expenses and apparatus	296.57	
		646.57
Mathematics and secretary's office—		
Assistants and clerk hire		1,848.24
Political economy		69.80
English literature and rhetoric—		
Assistant	$ 600.00	
Current expenses and student help	120.00	
		720.00
Domestic economy—		
Assistant	$ 600.00	
Current expenses and furniture	374.30	
		974.30
Music—		
Salary of director	$ 500.00	
Instrumental music at public exercises	100.00	
Current expenses	39.47	
		639.47
Library—		
Librarian	$ 600.00	
Assistant	350.00	
Expenses, books and periodicals	1,620.89	
Cabinet	120.50	
		2,691.39
Public grounds		1,326.37
Sabbath services		422.03
Public rooms—		
Heating, lighting and janitor service		432 05
Contingent expenses		6,719.82
Total net ordinary expenses		$70,496.40

It will be noticed that the aggregate of these detailed exhibits agrees with the "national support" items in the general statements.

In certain of the educational departments students are charged the cost of materials used in the laboratories; in other departments, such as the farm and creamery, there is a commercial feature connected with the educational work. These departments are credited with the proceeds of the sales of material and products and use the moneys thus received to meet in part the current expenses. These sales, and expenses equal thereto in amount, are not included in the statements given, such statements showing only the net income and net expenditures. In the first of the fiscal periods considered these sales aggregated $21,800.45; for the fiscal year ending June 30, 1899, they amounted to $33,720.98. Divided for this year according to departments, the account stands as follows:

RECEIPTS FROM SALES FOR THE YEAR ENDING JUNE 30, 1899.

Creamery	$ 19,033.94
Farm	6,973.34
Dairy	974.88
Mechanical department	3,121.44
Chemical department	952.60
Horticulture	645.48
Agricultural chemistry	480.60
Botany	393 00
Domestic economy	326.55
Physics and electrical engineering	300.05
Veterinary department	240.80
Zoology	213.31
Public grounds	31.89
Civil engineering	20.00
Mining engineering	2.50
Geology	3.35
Pathology	6 50
Library	.75
Total	$ 33,720.98

When, further along in this report, the account with the college treasurer is considered, the amount of these sales will be found to appear on both the debit and credit sides of his cash account. Such accounts, however, should not be taken into account in determining the income of the institution or the cost of its maintenance.

It is not practical to give in further detail the financial operations of each department. A statement regarding the farm and creamery may not, however, be out of place.

The farm statement is as follows:

DEBIT.

Inventory November 11, 1897	$14,402.37
Expenditures from November 11, 1897, to July 1, 1898	5,257.78

Cash expenditures for year ending June 30, 1899	9,095.66	
Unpaid bills	801.14	
Total		9,896.80
Total		$29,556.95

CREDIT.

Receipts from November 11, 1897, to July 1, 1898	$ 3,863.93
Receipts for year ending June 30, 1899	6,973.34
Inventory June 30, 1899	18,919.92
Total	$29,757.19

The excess of credits over debits shows a gain of $200.24. This is represented by:

Increase in inventory	$4,517.55
Less appropriations from interest fund and unpaid bills	4,317.31
Total	$ 200.24

It should be borne in mind in this connection that the main purpose of the entire farm plant, buildings, fields, and stock, is educational. Instead of showing a gain it would not be surprising if, like the other educational departments, its expenditures were to exceed the receipts. It can hardly be expected that in the long run the agricultural, any more than any other educational, department of the college can be self-sustaining.

The financial operations of the creamery are shown in the following exhibit:

DEBIT.

Inventory November 11, 1897		$ 689.31
Expenditures from November 11, 1897, to July 1, 1898		11,548.53
Cash expenditures for year ending June 30, 1899	$ 20,833.92	
Unpaid bills	87.12	
Total		20,921.04
Total		$33,158.88

CREDIT

Sales from November 11, 1897, to July 1, 1898	$11,797.31
Sales during year ending June 30, 1899	19,033.94
Inventory June 30, 1899, including $158.98 of collections due	1,101.85
Total	$ 31,933.10

Net cost of maintaining the creamery during the period	1,225.78
Total	$33,158.88
This is represented by:	
Appropriations from interest fund	$ 1,551 20
Unpaid bills	87.12
Total	$ 1,638 32
Less increase in inventory	42.54
Total	$ 1,225.78

These figures show that it cost about $800 per annum to maintain the creamery. Comparison with the cost of similar departments in other state colleges, where the commercial feature is not introduced, shows that the combination of the commercial and educational ideas lessens the cost of maintenance.. It at the same time adds greatly to the educational value of the creamery department.

II. NATIONAL APPROPRIATION FOR EXPERIMENT STATION.

	1897-8.		1898-9.	
	Part of year.		Full year.	
	Apppropriation.	Sales.	Appropriation.	Sales.
Income	$7,500.00	$1,324.36	$15,000	$2,343.34
Expenditures	7,521.81	1,311.51	15,000	2,355.81

By an act of congress known as the Hatch act of 1887, provision was made for the establishment of an experiment station in each state. An annual appropriation of $15,000 was made to each station for its support. By an act of the legislature the station in Iowa was made a department of the college. In addition to the services it has rendered the state in the conduct of valuable experiments it has incidentally been an important help to the educational side of the agricultural department. The provisions of the national law regarding the use of the station appropriation are exceedingly stringent. It must be kept entirely separate from the educational funds and at the close of each year a detailed report must be rendered the department of agriculture at Washington. The following is a summary of the report for the last fiscal year. The sales of the station are devoted to the same purposes as the appropriation itself, but under the law they are not included in the report.

Iowa Agricultural College Experiment Station, in account with the United States appropriation, 1898-9.

DR.

To receipts from the treasurer of the United States as per appropriation for fiscal year ending June 30, 1899, as per act of congress, approved March 2, 1887		$ 15,000

CR.

By salaries	$ 8,482.41	
By labor	2,370.73	
Publications	389.23	
Postage and stationery	359.41	
Freight and express	578.67	
Heat, light and water	405.10	
Chemical supplies	435.75	
Seeds, plants and sundry supplies	1,051.31	
Library	4.77	
Tools, implements and machinery	225.98	
Scientific apparatus	231.34	
Traveling expenses	372.20	
Contingent expenses	12.50	
Building and repairs	80.60	
Total		$ 15,000

HERMAN KNAPP,
Treasurer.

We, the undersigned duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the treasurer of the Iowa Agricultural College and Experiment Station for the fiscal year ending June 30, 1899; that we have found the same well kept and classified as above, and that the receipts for the year from the treasurer of the United States are shown to have been $15,000 and the corresponding disbursements $15,000; for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving no balance.

And we further certify that the expenditures have been solely for the purpose set forth in the act of congress approved March 2, 1887. Signed,

W. M. BEARDSHEAR,
E. W. STANTON.

[SEAL.]
Attest:
W. M. BEARDSHEAR,
Custodian.

III. MISCELLANEOUS ITEMS, ROOM RENT, DIPLOMA FEES AND RENTAL ON DONATED LAND.

The most important of the items considered under this head is the rental on rooms. Students and others rooming in the college dormitories are charged $3 per term. The fund thus realized is used to repair students' domitories and purchase furniture for student rooms.

The following exhibit shows the receipts and expenditures on account of this fund during the fiscal period:

RECEIPTS.

Balance on hand at the beginning of the fiscal period		$ 370.98
Received from students and teachers, 1898 (part of year)	$ 1,207 05	
Received from students and teachers, 1899	2,778 81	
Total		$ 3,985.86
Total available fund		$ 4,356.84

EXPENDITURES.

Main building—		
General repairs		1,064.04
Margaret hall—		
General repairs	$ 165.14	
Heating and lighting dining room and kitchen	382.25	
		$ 547.39
Boarding cottages—		
General repairs		112.33
Creamery dormitory—		
General repairs		8.63
Repairs on office building		1.05
Wages of general carpenter working on dormitory buildings		466 70
Furniture for students' rooms		685.48
Total expended		$ 2,885 62
Balance on hand		1,471.22
		$ 4,356.84

The receipts on the diploma account arise from a fee of $5 charged each graduate for his diploma. The fund is expended in the purchase of diplomas, programs, student register book, etc.

Rental is received on two small tracts of donated land. The receipts and expenditures on account of these two items are shown in the following summary:

	INCOME.		EXPENDITURES.	
	1897-8	1898-9	1897-8	1898-9
Room rent	$ 1,207.05	$ 2,778.81	$ 871.86	$ 2,013.76
Diploma fees	25.00	455.00	104.57	241.08
Rent on donated land	28.80	32 00	9.57	
Total	$ 1,260.85	$ 3,265.81	$ 986.00	$ 2,254.84

IV. ANNUAL STATE APPROPRIATION.

	1897-8.	1898-9.	TOTAL.
Income, drawn from state treasury	$11,578.53	$22,781.78	$34,360.31
Expenditures	11,585.47	22,790.75	34,376 22

The following is the section of the code granting this appropriation:

SECTION 2674. *Appropriations.*—For the repairs, general improvement and current expenses of the State College of Agriculture and Mechanic Arts, in its several departments and chairs, and in aid of the income fund, the sum of $18,500 is annually appropriated out of any money in the state treasury not otherwise appropriated.

At the time when the code went into effect there was in the state treasury an undrawn balance of the annual appropriations to the college of $9,575.11. This balance had been allowed to accumulate by the board to enable the college to erect a tower for the chimes and clock and make other needed improvements and repairs. The attorney-general rendered an opinion to the auditor of state in which he held that the new code in repealing former statutes deprived the board of trustees of authority to issue requisitions for this balance. The matter of granting them such authority was presented to the legislature and an act passed restoring to the college the amount in question. After paying for the erection of the tower $6,671.48 there remained a balance of $2,903.63 which was used for general repairs and improvements. The following statement shows the entire amount drawn from the state treasury during the period covered by this report and also the purposes for which it was expended:

INCOME (DRAWN FROM STATE TREASURY).

Amount of annual appropriation undrawn on October 1, 1897, when code went into effect; restored to college by legislative act	$ 9,575.11
Balance of annual appropriation for year ending June 30, 1898, drawn	12,272 91

Amount of annual appropriation for year ending June 30, 1899, drawn		12,512.29
Total drawn from the state treasury during fiscal period		$34,360.31

EXPENDITURES.

Agricultural hall—		
Gas machine for agricultural chemistry	$ 458.85	
Storm windows in recitation room	32.40	
Storm windows, ceiling, etc., for agricultural chemistry	109 76	
Shelves in agricultural chemistry laboratory	81.21	
Pathological laboratory	1,096.61	
Microscopes for pathology and histology	135 00	
Blackboard, photo room and office furniture for horticultural department	230.43	
Filter at room for agricultural physics	37.59	
General repairs on building	43.98	
		$ 2,225.83
Farm buildings—		
Improvements in cattle barn	$ 1,517.47	
Farm dairy room and sheep barn	1,925.17	
Farm foreman's house	1,042.90	
Implement shed	874.00	
Repairs on farm cottage	127.12	
Repairs on ice house	58.80	
Putting up windmill	52.57	
Repairing barns, hog house, and other general repairs	255.90	
		5,853.93
Fencing, tiling and repairing of north bridge		1,149.53
Experimentation		1,797.60
Creamery—		
Equipment for Pasteurization	$ 237.94	
Window caps	135.65	
Window shades and rollers, and farm dairy equipment	58.59	
Calcimining dormitory rooms	106.00	
Roof on boiler house	55.00	
General repairs	847.79	
Total		1,440.97
Tower for chimes and clock		6,671.48
Painting college buildings		1,657.60
Plumbing in college buildings (including carpenter work in connection therewith)		1,448 26
Fires, lights and incidentals, repairs		1,239.26
Carpenter shop—		
Equipment	$ 1,468.69	
Advertising for bids	17.36	
Total		1,486.05.

Chemical and physical building—			
Cases for physical department	$	597.75	
Floor for chemical lecture room		100.00	
Calcimining		97.23	
Sinks and faucets in chemical laboratory		66.93	
Repairing skylights, photo room, porch, papering wall for lantern screen, and making minor repairs		100.28	
Total			962.19
Professors' houses			1,329.07
Fire station, hook and ladder wagon, hose carts, hose and other fire department equipment			942.98
Engineering buildings—			
Hydraulic laboratory	$	827.48	
Repairing roof and gutters of engineering hall		323.00	
General repairs		95.88	
			1,246.36
Water works extension and repairs			884.08
Local telephone system			693.05
Furniture for public rooms			593.41
Sewage disposal plant—			
Completion of plant	$	319.04	
Maintenance of plant		139.15	
			458.19
Morrill hall—			
Cases for zoology	$	285.00	
Cases for geology and mining		28.00	
Gas machine for geology and zoology		86 61	
Screens for library		27.26	
Awnings for zoological rooms		12.70	
Fitting up room for repair of library books		33.59	
General repairs		56.70	
			529.86
Main building—			
Botany cases	$	247.81	
Blackboards in recitation rooms		54.60	
Wainscoting botany rooms		44.10	
General repairs		120.34	
			466.85
Sewer extension and repairs			211.00
Telephone and electric light repairs			148.22

Margaret hall—		
Fire escapes	$ 112.50	
Storm windows for domestic economy rooms	42.95	
General repairs	49.70	
		$ 205.15
Boarding cottages—		
General repairs		153 52
Boiler inspection		144.00
Lighting barns in winter		153.70
Repairs in south hall		81.12
Repairs in greenhouse		42.47
Repairs in horticultural foreman's house		10 00
Repairs in office building (including bath room)		69.83
Repairs in club house		9.95
Repairs in college hospital		14.90
Repairs in veterinary hospital		8.00
Advertising for bids		20.81
Telephone messages, postage and other miscellaneous matters		27.00
Total		$ 34,376.22

The excess of expenditures over amount drawn from state treasury is accounted for by a balance of $15.91 in the hands of the college treasurer at the beginning of the period.

The expenditure of this fund is under the general direction of the building committee. This committee selects from the repairs and improvements asked for by the heads of the different departments those which are the most urgent, and recommends them to the board. Such of these as the available funds will reach are ordered. Whenever the character of the work will permit bids are secured and contracts made. The execution of the work whether by contract or otherwise is generally under the direct supervision of the college engineer, Professor Marston, or the steward, Mr Cavell. The undrawn balance of the appropriation amounts to $5,987.11. Improvements and repairs have been authorized by the board amounting to about $7,500, a portion of the cost of which must necessarily be paid from the next quarterly payment due August 15th. Demands upon the fund, which the building committee considered urgent, amounting to over $10,000, were not granted because of want of means. Hitherto the fund has been used entirely for repairs, improvements, experimentation and the purchase of furniture for public rooms. Owing, however, to decreasing income from the endowments due to the lower rate of interest, and the increasing expense attendant upon the growth of the institution, the board of trustees was compelled at its annual meeting to set aside $6,500 of the fund to be used in aid of the national support funds. As this only partially meets the needs in that direction it is probable that an additional draft will be made upon this fund for general purposes before the close of the year.

V. SPECIAL APPROPRIATIONS BY THE STATE FOR BUILDINGS AND IMPROVEMENTS.

At the time of the last biennial report the following balances remained to the credit of the special appropriations of the Twenty-sixth General Assembly:

Deep well	$ 933.63
Water works	3,321.35
Forge shops and foundry, with fixtures	3,168.59
Remodeling farm barns	3.32
Sewage disposal system	3,455.45
Total	$ 10,882 34

These amounts have been extended for the purposes contemplated by law as follows:

1. Deep well—		
Part of balance due Henion & Hubbell on pump		$ 933.63
2. Water works—		
Balance due King Bridge Co., on contract of $8,888 for erection of tower and tank		1,335.92
Paid for fixing rods and slides in pump		97.24
Balance due Henion & Hubbell on pump less amount above paid for fixing rods and slides	$ 1,233 49	
Balance due Jackson & Moss on pumping station contract	345.00	
Paid Jackson & Moss, extras	88.63	
Pumping station fixtures	80.39	
Inside plumbing to connect college buildings with distribution system	99.37	
Minor items including stationery, postage, typewriting, engineer's expenses, and express	41 31	
		3,321.35
3. Forge shop and foundry with fixtures—		
Balance on Atkinson & Bro. contract of $3,469, for erecting of shop	$ 2,422.96	
Balance of architect's fee	86.60	
Stock house for coke and coal	86.73	

Benches, cases, line shaft and other necessary equipment	572 30	
		3,168.59
4. Remodeling farm barns—		
Carpenter work		3.32
5. Sewage disposal system—		
Contract of J. L. Black, sewage disposal plant	$ 2,421.45	
Contract of J. L. Black, 2,616 feet of sewers	840 60	
Sewers constructed in 1897, 715 feet	142.14	
Surveying, draughting and inspection	43.30	
Advertising	4.00	
Express, postage, telephone, freight, typewriting	3.96	
		3,455.45
Total		$ 10,882.34

The original appropriation of the legislature for the sewage disposal system was $3,500. The trustees had considerable difficulty in agreeing upon a satisfactory system. The work was thus delayed, and at the time of the meeting of the last legislature only $44.55 of the appropriation had been expended. A statement of the action of the board up to that time may be found on page 64 of the last biennial report. At the meeting of the trustees in April, 1898, the whole matter was referred to the committee on engineering departments with power to act. The committee decided to adopt the plan proposed by the college engineer, Professor Marston. Bids were received and the contract let in the following May. A list of the bids and a description of the plant will be found in the report of the college engineer.

The only special appropriation of the Twenty-seventh General Assembly to the college was one of $5,000 for a carpenter shop. The board at its meeting in April following the passage of the bill directed the building committee to advertise for bids and make contract for the erection of the building, the same to be completed by July 19th.

The committee met on the 29th of the month and opened the bids, which were as follows:

Zitterell & Atkinson	$ 4,387
Crellin & Lovell	4,694
W. M. Rich	4,397
H J. Fritz	5,400

The contract was awarded to Zitterell & Atkinson on the basis of their bid of $4,387. A bond of $2,500 was given conditioned upon the faithful performance of the contract. The building was completed to the satisfaction of the board of trustees for the price agreed upon. The account with the appropriation as a whole stands as follows:

RECEIPTS.

Amount of appropriation	$ 5,000

EXPENDITURES.

Zitterell & Atkinson's contract for erection of building	$ 4,387
Paid for steam heating, water supply and plumbing	613
Total	$ 5,000

The special appropriations asked by the board of the Twenty-eighth General Assembly are as follows;

General engineering hall for mechanical, civil, electrical and mining engineering	$ 150,000
President's residence	10,000
Horse barn and stock pavilion	10,000
Purchase of pure-bred stock	10,000
Total	$ 180,000

The board also asks that the annual appropriation be increased from $18,500 to $50,000 per annum, and that the college be granted one-tenth of a mill tax for five years, for buildings, improvements and equipment.

The urgent need of these appropriations is fully set forth in the president's report.

STEWARD'S DEPARTMENT ACCOUNTS.

In addition to the college proper with its various departments devoted to educational and experimental purposes the board of trustees has charge of an extensive dormitory system which furnishes rooms and table board to the greater portion of the students. The board also manages a college hospital supported by the student body.

THE BOARDING DEPARTMENT.

The boarding department is under the direct charge of a steward who receives a salary of $1,000 per annum and board, room, fires and lights for self and wife during the college terms and for such portion of the vacation as the college may need his services. The current expenses of the department are paid from its income and it is only incidentally in the repair of buildings that it receives any benefit from college funds. The following statement shows the receipts and disbursements for the period included in this report:

RECEIPTS.

From students and other sources in 1898 (part of year)	$ 11,386.76	
From students and others, 1898-9	27,580.67	
Total		$ 39,967.43

DISBURSEMENTS.

Paid for labor and supplies in 1898	$ 11,938.71	
Paid for labor and supplies in 1899	28,050.61	
Total		39,989.32
Excess of disbursements over receipts		21.89
This reduces the cash balance of $557.52 on hand at the beginning of the period to the present cash balance of		535.63
Add supplies on hand	$ 231.45	
Collections due	495.34	
Total	$ 726.79	
Deduct bills unpaid	30.75	
Total		696.04
Net credit, cash, supplies, etc		$ 1,231.67

As against a net balance at the beginning of the period as shown by the last biennial report of $724.68.

DEPARTMENT OF FIRES, LIGHTS AND INCIDENTALS.

Students rooming in the boarding cottages are charged 70 cents per week for fires, lights and incidentals; the charge in the other college buildings is 85 cents per week. Students boarding outside of the college pay into this fund $5 per term. The account also realizes a small profit on coal sold to parties living on the campus. If these sources of income are not sufficient to cover the expenses the deficit at the end of the year is paid by the college from its support funds, such payment being deemed a fair equivalent for heating, lighting and care of the public rooms. The following are the receipts and expenditures:

RECEIPTS.

Receipts from students and others, 1898 (part of year)	$ 6,256.22	
Receipts from students and others, 1898-9	13,930.90	
Total		$ 20,187.12
From college support fund, 1898	$ 1,960.38	
From college support fund, 1898-9	432.05	
Total		2,392.43
Total receipts		$ 22,579.55

EXPENDITURES.

For supplies and labor, 1898 (part of year)	$ 8,216.60	
For supplies and labor, 1898-9	14,362.95	
Total expenditures		$ 22,579.55

For several years Professor Bissell has had charge of the greater portion of the expenditures in this department. He has made a study of the problems connected with heating, lighting, pumping and plumbing, and his reports to the board have given much valuable information regarding the details of the care of the college buildings. The following is taken from his report for the year ending June 30, 1899:

Total expenditures for the year	$ 14,362.95	
Deduct amount received for coal and employes working for other departments	1,979.71	
Net cost of service for the year	$ 12,383.24	
Classified as follows:		
Janitor service		$ 3,607.31
Heating service		4,928 51
Lighting service		2,021.10
Water service		1,383.86
Plumbing service		179.34
Office expenses		190.75
Miscellaneous		72 37
Total		$ 12,383.24

The following shows the cost of heating the more important buildings during the period from January 1, 1899, to July 1, 1899:

Buildings	Cost.	Cubic feet of space heated.	Cost per mo. per 10,000 cubic feet.
Main building and Morrill hall	$1,192.35	800,000	$ 4 26
Margaret hall	598.39	275,000	6.20
Agricultural hall	172.41	75,000	4.60
Creamery	237.30	44,500	14.05
Music hall	21.64	30,000	2 05
Office	74.84	40,000	3.74
Cottages	164.59	120,000	4 57
Engineering buildings and chemical and physical buildings	525 27	440,000	3.41
Total	$ 2,986 79		

In the matter of electric lighting his report shows that the cost per lamp per month for the year was slightly in excess of 25 cents.

The cost of pumping is given at 5 cents per 1,000 gallons.

At the meeting of the board in July Professor Bissell was given full charge of the department.

COLLEGE HOSPITAL.

The college hospital is of the nature of an insurance company. The student pays at the beginning of each term the sum of $1.25, which entitles him to medical attendance, nursing and medicine and all the privileges of the hospital. Dr. W. E. Harriman is the physician in charge. He receives for his services an annual salary of $300, payable from the hospital fund. Thus far the income has proven sufficient to meet all expenses. The showing for the period from November 11, 1897, to June 30, 1899, is as follows:

RECEIPTS.

Cash on hand at the beginning of the period	$ 299.85
Receipts for period from November 11, 1897, to June 30, 1893	435.33
Receipts for year ending June 30, 1899	1,011.30
Total	$ 1,746 48

EXPENDITURES.

Paid for labor and supplies for the period from November 11, 1897, to June 30, 1898	$ 686.19
Paid for labor and supplies for the year ending June 30, 1899	903.85
Cash balance on hand	156.44
Total	$ 1,746.48

OTHER STEWARD ACCOUNTS.

Certain minor accounts of the steward's department may be summarized as follows:

	Old balance.	Receipts.	Expenditures.	Present balance.
Damages	$ 241.99	$ 92.15	$ 41.00	$ 293.14
Piano rent	1 50	116.00	76.30	41.20
Elocution fees		200.80	125.25	75.55

The present balance of the foregoing accounts together with:

Boarding department balance	$ 535.63
College hospital balance	156.44
Makes the total cash balance to the credit of the steward's department funds	$1.101.96

ACCOUNT WITH THE COLLEGE TREASURER.

As directed by law an account is kept by the secretary with the college treasurer. A monthly comparison of books is made with that officer and a monthly settlement thus effected. A classification of the treasurer's receipts and disbursements along the lines followed in the detailed presentation of the college finances will, exclusive of the steward's accounts, lead to the following exhibits:

(A) Receipts and disbursements of the college treasurer for the fiscal period from November 11, 1897, to July 1, 1898.

RECEIPTS.

Cash balance on hand November 11, 1897		$ 16,858.23
Total income from all sources, including nation support and experiment station funds, annual and special appropriations by the state and miscellaneous items		68,410.33
Sales by experiment station re-appropriated to the station	$ 1,324.36	
Sales by other departments re-appropriated to the departments	21,800.45	
Total		23,124.81
Accumulated interest fund paid in and transferred to the financial agency		23,575.00
Donated land sold		150.00
Total charged against the treasurer		$ 132,118.37

DISBURSEMENTS.

Total expenditures on account of educational departments, experiment station, repairs, improvements, furniture and diplomas		71,054.07
Experiment station sales, used by the station (except balance of 12.85)	$ 1,324.36	
Other department sales used by the departments	20,787.60	
Total		23,111.96
Accumulated interest endowment remitted to the state treasurer		24,105.00
Kintzley tract of land purchased		2,000.00
Proceeds of sale of donated land sent to state treasurer		150.00
Total disbursements		$ 120,421.03
Cash balance on hand June 30, 1898		11,697.34
Total		$ 132,118.37

(B) Receipts and disbursements of the college treasurer for the year ending June 30, 1899.

RECEIPTS.

Cash balance on hand July 1, 1898		$ 11,697.34
Receipts from all sources, including national support and experiment station funds, annual and special appropriations by the state, and miscellaneous items		119,646.92
Sales of the experiment station re-appropriated to the station	$ 2,343.34	
Sales of other departments re-appropriated to those departments	33,720.98	
		36,064.32
Accumulated interest endowment laid in and transferred to the financial agency		19,850.00
Total charged against the treasurer		$ 187,258.58

DISBURSEMENTS.

Total expenditures on account of educational departments, experiment station, repairs, improvements, buildings, furniture and diplomas		$ 117,962.81
Sales of the experiment station used by the station, including balance of $12.85	$ 2,355.81	
Sales of other departments used by those departments	33,720.98	
		36,076.79
Accumulated interest endowment fund remitted to state treasurer		19,850.00
Total disbursements		$ 173,889.60

Cash balance on hand June 30, 1899		**13,368.98**
Total		**$ 187,258 58**
The cash balance is to the credit of the following accounts:		
Interest fund	**$ 9,909.34**	
Morrill fund	**800.53**	**10,709.87**
Experiment station fund		**.38**
Railroad damages		**88.00**
Room rent		**1,471.22**
Diploma		**1,038.68**
Donation		**60.83**
Total		**$ 13,368.98**

Settlements are made with the treasurer by the board of trustees at the close of each fiscal year. A careful examination of his books and vouchers is made by a special committee appointed for that purpose. In July, 1898, Trustees Dixon and Robinson were the committee on settlement of the regular college accounts, while Trustees Watkins and Stout were assigned the steward's division. These committees reported the accounts correct, and the books neatly kept and in good condition. At the close of the fiscal year ending June 30, 1899, Trustees Dixon and Robinson were again appointed on the settlement committee, having charge this time of both college and the steward's accounts. The committee, after a careful examination in which they checked the duplicate receipts filed with the secretary with the debit side of the treasurer's cash account, compared his vouchers with the items on the credit side and tested the footings and balances, reported that the accounts were correct and that the cash on his hands amounted to $14,470.94, divided as follows:

General college accounts	$ 13,368.98
Steward department accounts	1,101.96
Total	$ 14,470.94

It will be noticed that these amounts agree with the balances already given in the exhibits taken from the secretary's books. The accounts of the treasurer are thus pretty thoroughly tested.

The board of trustees at its last annual meeting re-elected Herman Knapp treasurer. A full statement of his duties can be found on pages 83 and 84 of the last biennial report. His salary is the same as stated on page 86 of that report. His bond, which was fixed at $50,000, has been filed with the secretary of state and approved by him.

APPROPRIATIONS FOR FISCAL YEAR ENDING JUNE 30, 1900.

1. *From Collegiate Support Funds.*

The amount available for the year to pay the salaries of professors and instructors, provide for general expenses and meet the needs of the collegiate departments is estimated by the secretary at $73,500. Part of this amount is derived from the balance brought over from last year. The trustees, realizing that the endowment paid in could not be reloaned under the law fixing the rate of interest at 6 per cent, reduced appropriations to the lowest possible limit consistent with simply maintaining the present position of the institution. In this way an available balance was secured with which to meet in part the serious reduction in this year's income. The board also directed, as already stated, that $6,500 of the annual appropriation by the state should be devoted to general support purposes. Taking these items into account the estimated income is made up as follows:

Available balance	$ 4,000
Income from national support funds	63,000
Portion of state annual appropriation set aside for general support	6,500
Total	$73,500

The following are the appropriations made by the board of trustees:

APPROPRIATIONS FOR 1899-1900.

For salaries as per list under salaries for 1899-1900.		
From interest fund	$ 12,983 33	
From Morrill fund	22,550.00	
Total		$ 35,533.33
Agricultural department—		
Current expenses	$ 1,300	
Foreman, in addition to house	800	
Class expenses, including animal husbandry assistant and $100 increase in Mr. Atkinson's salary	650.00	
Total		2,750.00

Creamery—		
Current expenses and instruction		1,000 00
Dairy—		
Current expenses and apparatus	$ 100.00	
Salary of G. L. McKay, director	1,300.00	
Salary of assistant	400.00	
Total		1,800.00
Department of horticulture—		
Assistant	$ 400.00	
Current expenses and apparatus, including greenhouse instructor	1,500.00	
Total		1,900.00
Veterinary department—		
House surgeon	$ 200.00	
Current expenses and apparatus	350.00	
		550.00
Mechanical department—		
Assistants	$ 3,155.00	
Current expenses and equipment	1,000.00	
		4,155.00
Civil engineering department—		
Assistant	$ 800.00	
Current expenses and equipment, including sewage disposal experiments	1,150.00	
		1,950.00
Physics and electrical engineering—		
Assistants	$ 1,500.00	
Current expenses and apparatus	900 00	
		2,400.00
Mining engineering—		
Current expenses and equipment		300.00
Military department—		
Current expenses and flags		100.00
Agricultural chemistry—		
Assistants, current expenses and apparatus		700.00
Department of chemistry—		
Assistants	$ 950 00	
Current expenses and apparatus	500.00	
		1,450.00
Geology—		
Current expenses and equipment		200.00

Department of zoology—		
Assistant	$ 300.00	
Current expenses, increase of equipment and additions to museum	300.00	
		600.00
Pathological department—		
Current expenses and apparatus		50.00
Histology—		
Current expenses and apparatus		50.00
Department of botany—		
Assistants	$ 350.00	
Current expenses and apparatus	300.00	
		650.00
Mathematics and secretary's office—		
Assistants and clerk hire		1,400.00
Department of English literature and rhetoric—		
Assistants (three)	$ 1,600.00	
Student help and current expenses	200.00	
		1,800.00
Political economy—		
Current expenses and equipment		75.00
Department of domestic economy—		
Assistant	$ 600.00	
Current expenses and equipment	300 00	
		900.00
Department of music—		
Salary of director and band instructor	500.00	
Instrumental music at public exercises	100.00	
Current expenses	50.00	
Piano	275.00	
		925.00
Library—		
Librarian	$ 600.00	
Assistant	350.00	
Current expenses, books and periodicals, including student assistant	1,800.00	
		2,750.00
Sabbath services		450.00
Public grounds		1,220.00
Public rooms—		
Heating, lighting and janitor service		1,500.00
Contingent expense—		
Private secretary and clerk for president's office	$ 1,025.00	
Catalogues, printing, stationery and advertising	2,750.00	

Extra fund for advertising	500.00	
Telephone service	80.00	
Ringing bell for recitations	75.00	
Mail service	270.00	
Proctors	400.00	
Preceptress fund	150.00	
Pumping pipe organ	25.00	
Clerks for treasurer's office	350.00	
Emergency	150.00	
Department of history	25.00	
French and German	135.00	
Physical culture for ladies	125.00	
Advertising in Student	50.00	
Advertising in Junior annual for 1900, the annual to contain nothing not approved by the president	50.00	
Address before college and trustees	100.00	
Annual fee for agricultural college association	10.00	
Fund for attending teachers' institutes and associations (intended for president and professors authorized by the president to attend such meetings)	70.00	
Commencement write-up	20.00	
New ledger for treasurer's office	15.00	
Typewriter for president's office	90.00	6,465 00
Total		$ 73,623.33

The largest item in this list of appropriations is, of course, the cost of instruction. A part of this cost appears under the head of salaries. Assistants however, are, with one or two exceptions, charged to the department accounts. Under the head of salaries the list in detail is as follows:

SALARIES FOR 1899-1900.

W. M. Beardshear, A. M., LL. D., president, psychology and ethics	$3,850.00
M. Stalker, M. Sc., V. S , veterinary science, station veterinarian	1,600.00
E. W. Stanton, M. Sc., mathematics and economic science, secretary of board of trustees	2,400.00
J. R. Lincoln, military science	1,000.00
Afred A. Bennett, M. Sc., chemistry	1,800.00
H. E. Summers, B. S., zoology station entomologist	1,600.00
W. H. Wynn, Ph. D., D. D., history	1,200.00
L. H. Pammel, B. Ag., M. Sc., Ph. D , botany, station botanist	1,800.00
Miss Gertrude Coburn, B. Sc., domestic economy	1,200.00
C. F. Curtiss, M. S. Ag., agricultural director, experiment station	2,000.00
J. B. Weems, Ph. D., agricultural chemistry, station chemist	1,600.00
A. B. Noble, B. Ph., rhetoric and English literature	1,600.00
L. B. Spinney, B. M. E., M. Sc., physics and electrical engineering	1,500.00
G. W. Bissell, M. E., mechanical engineering	1,600.00

A. Marston, C. E., civil engineering, college engineer	2,000.00
Miss Lizzie May Allis, B. A., M. A., French and German	1,200.00
Mrs. Sally S. Smith, B. S., preceptress	750.00
W. E. Harriman, B. Sc., M. D.	700.00
Histology and physiology ($700) college physican ($300) paid from hospital fees charged students	1,000.00
W. H. Meeker, M. E., assistant in mechanical engineering	1,400.00
A. M. Newens B. O., elocution and oratory, associate in English	1,200.00
S. W. Beyer, B. Sc., Ph. D., geology and mining	1,600.00
John A. Craig, B. S. A., animal husbandry	1,800.00
John A. Craig, B. Ag., horticultural station horticulturist	2,000 00
J. J. Repp, V. D. M., assistant in pathology and therapeutics	1,200.00
Miss Maria M. Roberts, B. L., mathematics	900.00
James Atkinson, B. S. A, assistant in station ($100 additional charged to farm department)	800.00
Herman Knapp, B. S. A., college treasurer and recorder, station treasurer ($250)	1,100.00
Due General Lincoln on salary account at beginning of fiscal year	133.33
Total appropriation for salaries	$41,533.33

Houses on the college grounds are occupied by Professors Noble, Summers, Curtiss, Marston, Bissell, Weems and Stanton. Their annual rental is considered by the board to be equivalent to $200. The salaries included in the salary list were ordered charged to the following funds:

Support funds:		
Morrill fund	$22,550.00	
Interest fund	12,983.33	
Total		$35,533.33
Experiment station fund		6,000.00
Total		$41,533.33

Though the salaries of assistants are at first charged to department accounts they are, of course, ultimately paid from the funds which support these departments.

The following is a list of assistants, with the salary of each and the fund from which it is paid:

SALARIES OF INSTRUCTORS AND ASSISTANTS.

NAME AND DEPARTMENT.	Support funds.	Experiment station funds.	TOTAL.
G. L. McKay, dairy	$ 1,300		$ 1,300
O. H. Eckles, dairy	400	400	800
H. J. Evans, creamery	500		500
J. J. Edgerton, farm (house rent in addition)	800		800
Jas. Atkinson, agriculture	100		100
G. M. Rommel, animal husbandry	200	200	400
F. J. Resler, music	500		500
Mrs. Elizabeth Restler music	100		100
Elmina Wilson, civil engineering	800		800
T. Lennox, mechanical engineering	1,080		1,080
E. O. Potter, mechanical engineering	810		810
E. O. Boutelle, mechanical engineering	765		765
G. F. Dodge, mechanical engineering	500		500
Miss Bessie Larrabee, Latin	600		600
Miss L. Simonson, English	500		500
Miss Elizabeth McLean, English	500		500
R. E. King, physics	450		450
E. G. Reed, physics	450		450
Lola Placeway, chemistry	650		650
Hazel Beardshear, chemistry	300		300
………… . . , physical culture for ladies	125		125
Miss Maud Gardiner, domestic economy	600		600
J. J. Vernon, horticulture	400	200	600
P. T. Barnes	600		600
B. H. Hibbard, mathematics	400		400
Julia A. Wentch, mathematics	750		750
H. W. Grettenberg, agricultural chemistry	400		400
A. Estella Paddock, botany	175	150	325
Elmer Hodson, botany	175	150	325
J. R. Allen, zoology	300		300
Vina E. Clark, library	600		600
Helen Louise Knapp, library	350		350
W. W. Otto, library	100		100
S. P. Smith, house surgeon	200		200
Ira A. Williams, geology and mining engineering	200		200
J. O. Brown, chemistry		400	400
Wilmon Newell, entomology		400	400
E. E. Little, horticulture		200	200
Miss O. M. King, artist		375	375
Total	$16,680	$ 2.475	$19,155

This makes the total salary appropriation for the college and station $60,688.33.

Considering now the appropriations as a whole, those made from the support funds may be classified as follows:

Salaries charged to salary account	$ 35,533.33	
Salaries of assistants charged to department account	16,680	
Total		$ 52,213.33
General expenses of the college		10,285.00
Current expenses of departments		8,625.00
Total for salaries and current expenses		$ 71,123.33
Additions to library, apparatus and collections		2,500.00
Total appropriations from support funds		$ 73,523.33

It will be seen from this analysis that the college has only $2,500 available with which to meet the urgent demands for increased laboratory and library facilities which the rapid growth of the institution renders imperative.

The following action of the board relates to the expenditure of the department appropriations.

First.—The secretary was directed to notify the heads of departments that the appropriations made will exhaust the income for the year and that the board desires the utmost possible economy in the expenditure of such appropriations.

Second.—It was ordered that not more than one-half of the appropriation to any department for the purchase of apparatus be expended before January 1, except upon the approval of the board of audit before the expenditure is made.

Third.—Each department was authorized to use its ordinary income to meet in part its current expenses.

Fourth.—The following order looking to the prompt payment of bills was adopted:

"Heads of departments and other officers employing labor or purchasing materials or supplies of any kind on account of the college, will be held responsible for the presentation of a proper bill for the same, to the board of audit on or before the 20th day of the month following that in which the expense is incurred; any bill not presented by this date shall be considered an 'old bill.' The board of audit shall report to the treasurer at the end of each month the amount of such old bills filed during the month, and the treasurer is directed to deduct from the salary of the officer employing the labor or making the purchase the amount of the bills thus unpaid. Such bills shall be presented to the board of trustees at their next meeting and if allowed the salary reserved shall be paid by the treasurer to the amount of the bills allowed.

"*Second.*—Bills for expenses incurred in the month of June shall be presented by the heads of the departments on or before a date to be fixed by the board of trustees or the president of the college."

II. APPROPRIATIONS FROM EXPERIMENT STATION FUND 1899-1900.

Upon the recommendation of the station council this fund was divided among the different sections as follows:

DIVISION OF EXPERIMENT STATION FUND FOR 1899-1900.

1. **Salaries of station staff—**		
C. F. Curtiss	$ 1,350.00	
J. B. Weems	900.00	
John A. Craig	900.00	
J. J. Repp	900.00	
James Atkinson	800.00	
H. E. Summers	300.00	
L. H. Pammel	300.00	
John Craig	300.00	
Herman Knapp	250.00	
		$6,000.00
2. **Salaries of assistants—**		
Assistant for chemical section	$ 400.00	
Assistant for botanical section	300.00	
Assistant for dairy section	400.00	
Assistant for entomological section	400.00	
Assistant for horticultural section	400.00	
Artist	375.00	
		$ 2,275.00
3. **Appropriations to sections—**		
Chemistry	$ 556.00	
Botany	188.17	
Dairy	515.47	
Entomology	252.00	
Horticulture	461.48	
Veterinary	368.15	
Agriculture, including salary of assistant in animal husbandry, and $195 for building and repairs	1,902.07	
		$ 4,243.34
4. General expenses, including heating of building, janitor service, mail and express, water, etc.		891.66
5. Stenographer		240.00
6. Bulletin fund		1,350.00
Total		$ 15,000.00

The salaries of the station staff, appearing in the foregoing exhibit, represent simply the portion of the salaries of these officers charged to this fund, and are not additional to the salaries already given in the salary list. The same is true of the assistants.

The president of the college was given authority, when it should appear that there was an unused surplus in any section and a demand for funds in another, to call the station council together for a reapportionment of the funds to meet such emergency.

The board of trustees directed that hereafter the accounts of the different sections be kept separate upon the books of the secretary and treasurer and managed in the same way as the regular college departments. The sum of $1,550 was set aside for the use of the station upon condition that so much as may be found necessary be applied to the payment of bills of the station for the fiscal year ending June 30, 1899, and that the remainder of said amount be placed to the credit of the agricultural section.

MATTERS RELATING TO STUDENTS.

The expenses charged against the students remain the same as in the last biennial report. As there stated, the entire cost to a student entering college, of board, fires, lights, laundry, books and incidentals for the school year of thirty-three weeks will be from $140 to $150, according to the course of study chosen. The expense of students of the higher classes will be somewhat in excess of these amounts, owing to the laboratory fees and the greater cost of books used.

Owing to the change in the beginning of the fiscal year from November to July, only one commencement is included in the period. The following is the list of graduates of this class of 1898:

In the course in agriculture	14
In the course in science related to the industries	32
In the course in mechanical engineering	7
In the course in civil engineering	6
In the course in electrical engineering	10
In the course for women	12
In the course in veterinary science	4
Total	85

Appropriate degrees were conferred upon these graduates.

The degree of master of science (M. Sc.) was conferred upon E. D. Ball and Robert Combs; the degree of master of agriculture (M. Ag.) upon I. J. Mead, H. C. Taylor and J. W. Wilson; the degree of master of philosophy (M. Ph.) upon C. H. McLean.

Respectfully submitted,

E. W. STANTON,
Secretary.